UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
WACO DIVISION

EMERGENT MOBILE LLC, **Plaintiff,** **v.** **LG ELECTRONICS, INC., and** **LG ELECTRONICS U.S.A., INC.,** **Defendants.**	**Case No. 6:21-cv-00629** **JURY TRIAL DEMANDED**

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Emergent Mobile LLC ("Emergent Mobile"), by and through its undersigned counsel, files this Complaint against Defendants LG Electronics, Inc. ("LGE") and LG Electronics U.S.A. Inc. ("LGEUS") (collectively "Defendants" or "LG") for patent infringement of United States Patent Nos. 9,819,506; 9,198,014 and 9,097,530 (the "Patents-in-Suit") and alleges as follows:

NATURE OF THE ACTION

1. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. § 1 et seq., including 35 U.S.C. §§ 271, 281, 283, 284, and 285.

PARTIES

2. Plaintiff Emergent Mobile LLC is organized under the laws of Texas, having its principal place of business at 1150 Empire Central Place #112, Dallas, Texas 75247.

3. Defendant LGE is a corporation organized under the laws of South Korea, with its principal place of business at LG Twin Towers, 128 Yeoui-daero, Yeongdungpo-gu, Seoul, 07366, South Korea. Defendant LGE directly and/or through one or more of its subsidiaries, affiliates, and/or intermediaries, including though Defendant LGEUS, conducts business in and is doing business in Texas and in this District and elsewhere in the United States, including, without limitation, using, offering to sell, selling, and/or importing mobile communications devices such as mobile phones, smartphones, and tablet PCs that embody the patented technology, enabling third party distributors and resellers to sell and offer to sell mobile communication devices, and enabling end-user purchasers to use such devices in this District. LGE is a parent corporation of Defendant LGEUS.

4. Defendant LGEUS is a corporation organized under the laws of the State of Delaware, with regular and established places of business in Texas at least at 9420 Research Blvd, Austin, Texas 78759; 21251-2155 Eagle Parkway, Fort Worth, Texas 76177; and 14901 Beach St, Fort Worth, Texas 76177. LGEUS's registered agent for service of process in the State of Texas is United States Corporation Co. 211 E. 7th Street, Suite 620, Austin, TX 78701 or wherever they may be found. LGEUS has headquarters at 1000 Sylvan Avenue, Englewood Cliffs, NJ 07632. Upon information and belief, LGEUS supports LGE's smartphone, mobile device, tablets, and TV business in the United States with local logistics, local sales, repair, and technical support. Upon information and belief, LGEUS has also established warehouse locations in the United States. Defendant LGEUS conducts business in and is doing business in Texas and in this District and elsewhere in the United States, including, without limitation, using, offering to sell, selling, and/or importing mobile communications devices such as mobile phones, smartphones, tablet PCs, and

TVs that embody the patented technology, enabling third party distributors and resellers to sell and offer to sell mobile communications devices, and enabling end-user purchasers to use such devices in this District.

5. Upon information and belief, LGE controls and is the majority owner of LGEUS. LGE and LGEUS design, manufacture, use, import into the United States, sell, and/or offer for sale in the United States smartphones and other mobile devices under the "LG" brand.

6. Upon information and belief, LGE and its United States-based subsidiaries including LGEUS (which act as part of a global network of overseas sales and manufacturing subsidiaries on behalf of LGE) have operated as agents of one another and as parts of the same business group to work in concert together and enter into agreements with one another that are nearer than arm's length. For example, LGE alone and through at least LGEUS's activities, conducts business in the United States, including importing, distributing, and selling mobile devices that infringe the Patents in Suit in Texas and in this District. Through offers to sell, sales, imports, distributions, and other related agreements to transfer ownership of Defendants' mobile devices with distributors and customers operating in and maintaining a significant business presence in the United States and in this District, and/or its U.S. subsidiary LGEUS, LGE does business in Texas, and in this District.

7. Defendants offer for sale, and/or sell smartphones, other mobile devices, and TVs throughout the United States, including within this District that incorporate the infringing technologies.

8. Defendants have and/or maintain authorized sellers and sales representatives that offer and sell products pertinent to this Complaint throughout the State of Texas, including this

District and to consumers throughout this District, such as: AT&T Store at 4330 W Waco Drive, Waco, Texas 76710; Verizon Authorized Retailer at 2812 W Loop 340, Suite# H-12, Waco, Texas 76711; Best Buy at 4627 S Jack Kultgen Expy, Waco, Texas 76706; and Amazon.com.

JURISDICTION AND VENUE

9. This action arises under the patent laws of the United States, Titles 35 of the United States Code ("U.S.C.") § 101 et seq.

10. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

11. This Court has personal jurisdiction over Defendants, because, directly or through intermediaries, each Defendant has committed acts within the Western District of Texas giving rise to this action and/or has established minimum contacts with the Western District of Texas such that the exercise of jurisdiction would not offend traditional notions of fair play and substantial justice.

12. For example, LGEUS maintains a regular and established place of business at 9420 Research Blvd, Austin, Texas 78759. LGEUS's registered agent for service of process in the State of Texas is Corporation Service Company, 211 E. 7th Street, Suite 620 Austin, Texas 78701-3218.

13. Further, on information and belief, LGE directs and controls the actions of LGEUS such that it too maintains regular and established offices in the Western district of Texas, including at 9420 Research Blvd, Austin Texas 78759.

14. In addition, Defendants have placed or contributed to placing infringing products into the stream of commerce via and established distribution channel knowing or understanding

that such products would be sold and used in the United States, including in the Western District of Texas

15. On information and belief, Defendants also have each derived substantial revenue from infringing acts in the Western District of Texas, including from the sale and use of infringing products.

16. Venue is proper in this judicial district under 28 U.S.C. § 1391(b)-(c) and 28 U.S.C. §1400.

17. In particular, LGE is a corporation organized and existing under the laws of the Republic of Korea, and LGEUS has maintained regular and established places of business at 9420 Research Blvd, Austin, Texas 78759.

18. On information and belief, each Defendant exercises direction and control over the performance of each other Defendant, or they form a joint enterprise such that the performance by one Defendant is attributable to each other Defendants.

THE ASSERTED PATENTS

United States Patent No. 9,819,506

19. On November 14, 2017, the United States Patent and Trademark Office duly and legally issued United States Patent No. 9,819,506 ("the '506 patent") entitled "Method for Transmission and Reception in Point-Multipoint Radio Broadcasting of Multilanguage Messages in Cellular Mobile Communications, Mobile Telecommunications Network and Mobile Terminal for the Embodiment of the Method" to inventor David F. Sorrells et al.

20. The '506 patent is presumed valid under 35 U.S.C. § 282.

21. Emergent Mobile owns all rights, title, and interest in the '506 patent.

United States Patent No. 9,198,014

22. On November 24, 2015, the United States Patent and Trademark Office duly and legally issued United States Patent No. 9,198,014 ("the '014 patent") entitled "Process and Apparatus for Cooperating Transmission of an Alarm" to inventor Paolo D'Amato et al.

23. The '014 patent is presumed valid under 35 U.S.C. § 282.

24. Emergent Mobile owns all rights, title, and interest in the '014 patent.

United States Patent No. 9,097,530

25. On August 4, 2015, the United States Patent and Trademark Office duly and legally issued United States Patent No. 9,097,530 ("the '530 patent") entitled "Method For Ensuring Continuity Of Service Of A Personal Navigation Device And Device Thereof" to inventor Saverio Celia.

26. The '530 patent is presumed valid under 35 U.S.C. § 282.

27. Emergent Mobile owns all rights, title, and interest in the '530 patent.

CLAIMS FOR RELIEF

COUNT I – Infringement of United States Patent No. 9,819,506

28. Plaintiff hereby realleges paragraphs 1 through 27 as though fully set forth herein.

29. LG directly and/or through its subsidiaries, affiliates, agents, and/or business partners, have in the past and continue to directly infringe at least claims 8 and 10 of the '506 Patent pursuant to 35 U.S.C. § 271(a) by making, using, selling, offering for sale, and/or importing in the United States (the "'506 Accused Products.)

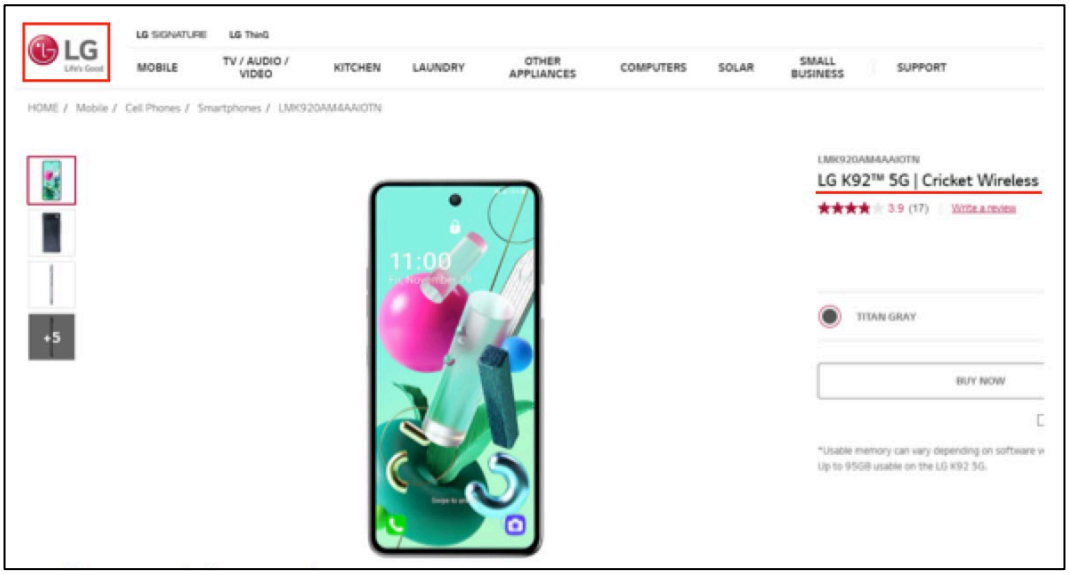
30. LG products that infringe one or more claims of the '506 patent include, but are not limited to, 4G and 5G phones and smartphones, including but not limited to the LG W series, LG Velvet series, LG K series, LG Q series, LG V series, LG G series, LG X series, LG Signature Edition Series, LG Stylo series, LG Wing, and the like.[1]

31. Regarding claim 8:

A mobile terminal configured to receive a broadcast message and adapted to operate in a cellular mobile telecommunications system with broadcast functionality,

For example, but not by way of limitation, the '504 Accused Products, such as LG's K92 smartphones support LTE network and support Wireless Emergency Alerts (WEA) feature. LTS standard specification (i.e., 3GPP TS 23.041 version 16.4) delineates technical realization of a cell broadcast service. The cell broadcast service delivers emergency alerts/messages on a mobile device configured for receiving ETWS (Earthquake and Tsunami Warning System) or CMAS (Commercial Mobile Alert System) messages, these messages are also known as wireless emergency alerts (WEA) where the mobile device is operating in an LTE network.

[1] Plaintiff reserves the right to add additional infringing devices for its infringement contentions.



Specifications

Network frequency	GSM: 850/900/1800/1900MHz, UMTS/HSPA+ Bands: B1/B2/B4/B5, LTE Bands: B1/B2/B3/B4/B5/B7/B12/B14/B20/ B29/B30/B38/B39/B40/B41/B66 5G Bands: n2/ n5/ n66

Wireless Emergency Alerts

You can view emergency alerts and customize your emergency alert settings. On the settings screen, tap **Network & internet > Wireless Emergency Alerts**.

ETSI TS 123 041 V16.4.0 (2020-07)

Digital cellular telecommunications system (Phase 2+) (GSM);
Universal Mobile Telecommunications System (UMTS);
LTE;
5G;
Technical realization of Cell Broadcast Service (CBS)
(3GPP TS 23.041 version 16.4.0 Release 16)

2 General description

PWS provides a service that allows the network to distribute warning messages on behalf of public authority. PWS enables the distribution of ETWS, CMAS (aka WEA), KPAS and EU-Alert warning messages in GSM, UMTS, E-UTRAN, and NG-RAN.

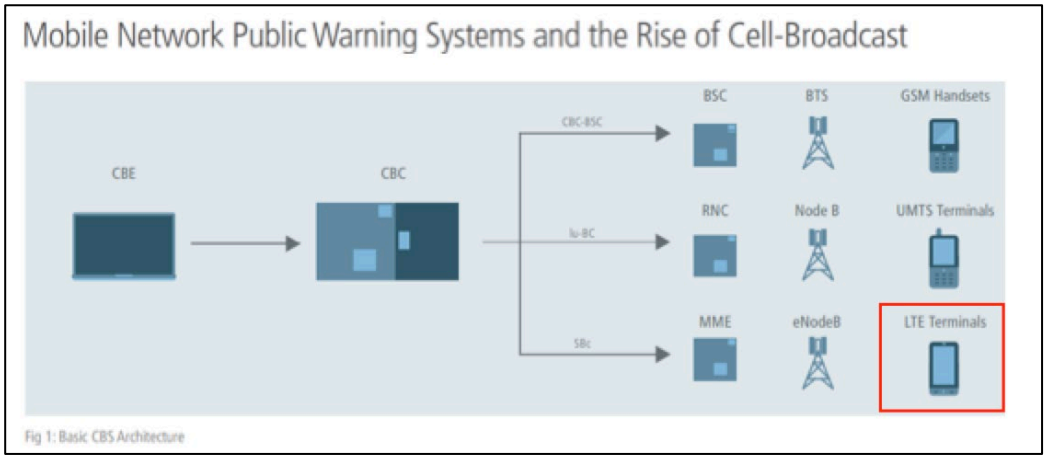
WEA Wireless Emergency Alert

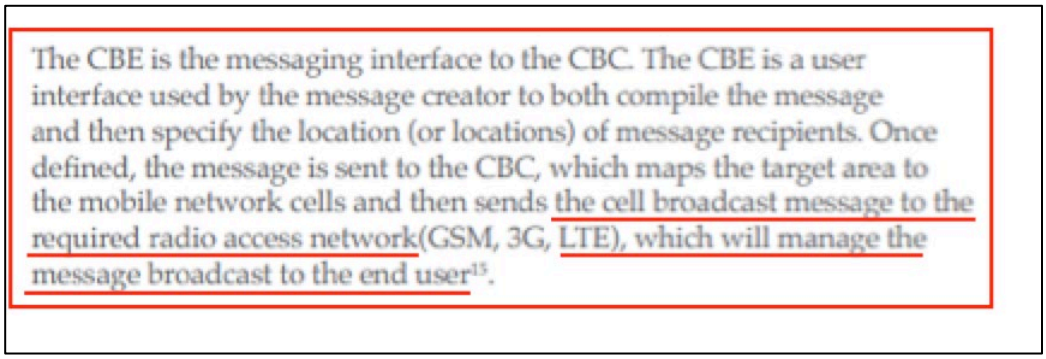
9.1.3 Warning Message Delivery

9.1.3.1 General

In E-UTRAN, an ETWS capable UE or a CMAS capable UE uses the procedures as outlined in subclause 9.1.3.4. See 3GPP TS 36.331 [36] for details on the radio interface.

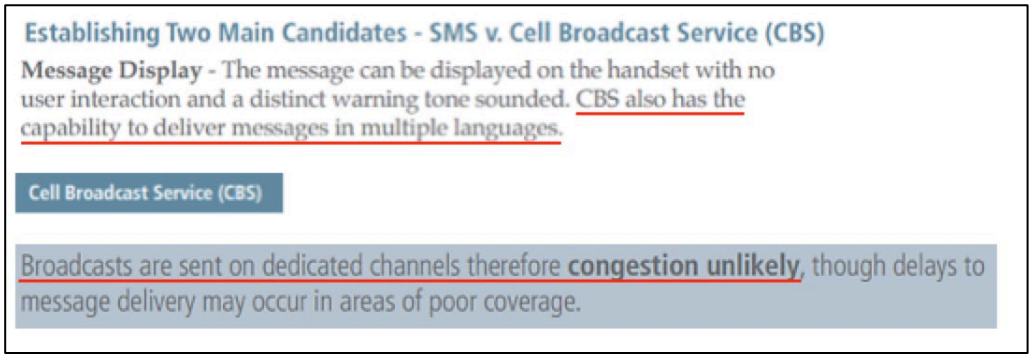
A UE in limited service state, and configured according to the USIM data file to display warning messages on that PLMN, shall display warning messages to the user.

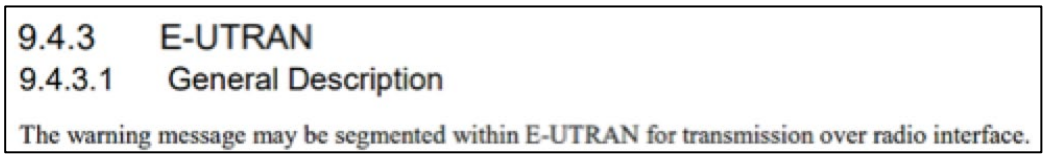


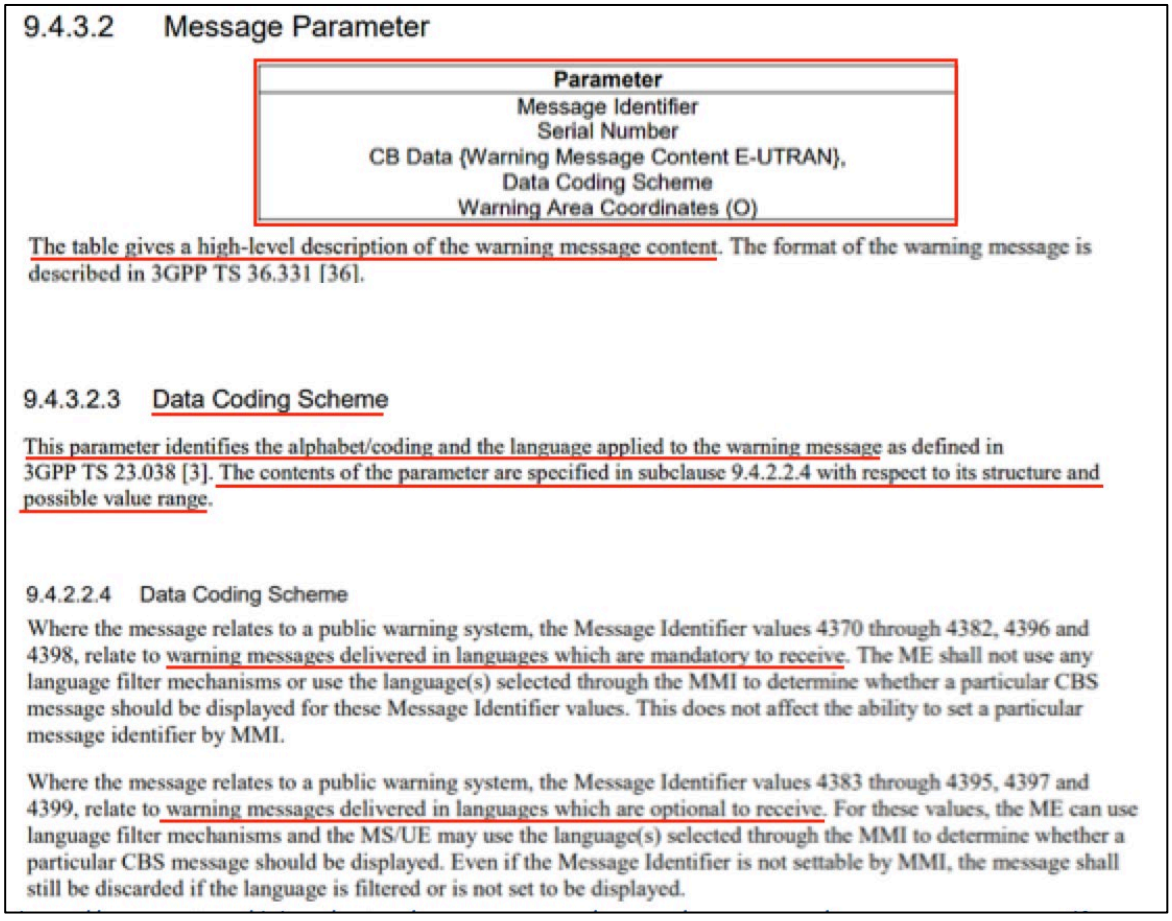

The CBE is the messaging interface to the CBC. The CBE is a user interface used by the message creator to both compile the message and then specify the location (or locations) of message recipients. Once defined, the message is sent to the CBC, which maps the target area to the mobile network cells and then sends the cell broadcast message to the required radio access network(GSM, 3G, LTE), which will manage the message broadcast to the end user[15].

receive one or more multilanguage broadcast messages from the cellular mobile telecommunications system, said one or more multilanguage broadcast messages being included in blocks of a broadcast channel in a set of languages preferred by users of a plurality of said mobile terminals;

The cell broadcast service can deliver emergency alert messages in multiple languages using dedicated broadcast channels where congestion is unlikely. As seen in below evidence, the messages include data coding scheme, which identifies the language applied to the message.







interpret a piece of information relating to at least one language identifier in each of said one or more multilanguage broadcast messages;

Using the data coding scheme contained in the messages, the mobile device interprets the messages.

9.4.3 E-UTRAN

9.4.3.1 General Description

The warning message may be segmented within E-UTRAN for transmission over radio interface.

9.4.3.2 Message Parameter

Parameter
Message Identifier
Serial Number
CB Data {Warning Message Content E-UTRAN},
Data Coding Scheme
Warning Area Coordinates (O)

The table gives a high-level description of the warning message content. The format of the warning message is described in 3GPP TS 36.331 [36].

2 General description

To permit mobiles to selectively display only those CBS messages required by the MS/UE user, CBS messages are assigned a message class which categorises the type of information that they contain and the language (Data Coding Scheme) in which the CBS message has been compiled. Through the use of appropriate MMI, the user is then able to ignore message types that he does not wish to receive, e.g. advertising information or messages in an unfamiliar language.

What does a CBS message look like?

The basic structure for a single message page[12] is as shown on the following page:

Octet Number (1 octet = 8 Bits)	Field
5	**Data Coding Scheme** If the message is not set to immediate display, this parameter tells the mobile handset how to display the message and which alphabet/language to use when interpreting the message. Through the use of an interface on the handset the user is able to ignore messages in an unfamiliar language. However, some warning messages may be transmitted in mandatory languages that are forcibly displayed.

compare said at least one language identifier of each message with at least one identifier of a user's preferred language chosen by a user of the mobile terminal and stored in the hardware memory of the mobile terminal identifying the language used in the mobile terminal;

Using the mobile device, a user can set a preferred language for displaying the messages in that language. The set language preference is stored in the SIM of the mobile device. The revived messages are compared with the set language preference stored in the SIM.

> 9.4.3.2.3 Data Coding Scheme
>
> This parameter identifies the alphabet/coding and the language applied to the warning message as defined in 3GPP TS 23.038 [3]. The contents of the parameter are specified in subclause 9.4.2.2.4 with respect to its structure and possible value range.

> 9.4.2.2.4 Data Coding Scheme
>
> This parameter identifies the the alphabet/coding and the language applied to a CBS Message as defined in 3GPP TS 23.038 [3].
>
> When the USIM indicates one or more language preferences, the UE shall, by default, use the language(s) stored in the USIM (in the EF_{PL} file) to set any language filter mechanisms provided by the UE.
>
> Optionally, when allowed by language code processing specified below, the user can select the language(s) required by using an MMI, to determine whether a particular CBS message should be displayed.

select the message for which a match is found through said comparison; and
display the selected message;

Based on the set language preference, the messages are displayed in the preferred language.

> 9.4.2.2.4 Data Coding Scheme
>
> This parameter identifies the the alphabet/coding and the language applied to a CBS Message as defined in 3GPP TS 23.038 [3].
>
> When the USIM indicates one or more language preferences, the UE shall, by default, use the language(s) stored in the USIM (in the EF_{PL} file) to set any language filter mechanisms provided by the UE.
>
> Optionally, when allowed by language code processing specified below, the user can select the language(s) required by using an MMI, to determine whether a particular CBS message should be displayed.

> 2 General description
>
> To permit mobiles to selectively display only those CBS messages required by the MS/UE user, CBS messages are assigned a message class which categorises the type of information that they contain and the language (Data Coding Scheme) in which the CBS message has been compiled. Through the use of appropriate MMI, the user is then able to ignore message types that he does not wish to receive, e.g. advertising information or messages in an unfamiliar language.

wherein the mobile terminal is adapted to manage broadcast-type mobile communication in accordance with any one of the 3GPP (3rd Generation Partnership Project), UMTS (Universal Mobile Telecommunications System), GPRS (General Packet Radio Service), GSM (Global System or Mobile Communications) standards, wherein said Multilanguage messages are structured according to the System Information Block 10 and/or System Information Block 11 and/or System Information Block 12 types.

The mobile device operating in LTE network can receive and display cell broadcast messages. The messages can be structured according to the system information block 10, 11 or 12 types.

Mobile Network Public Warning Systems and the Rise of Cell-Broadcast

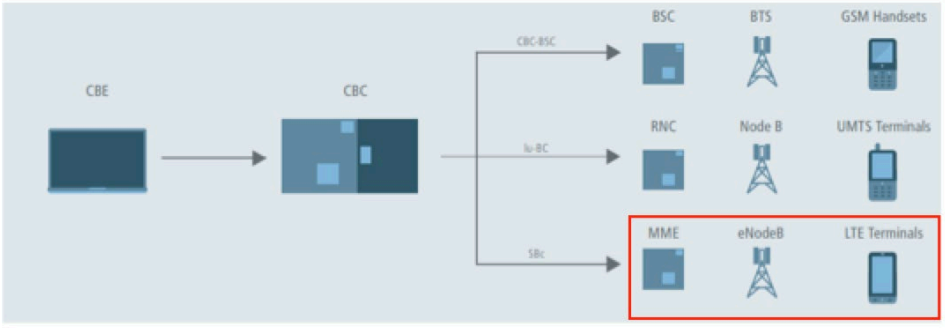
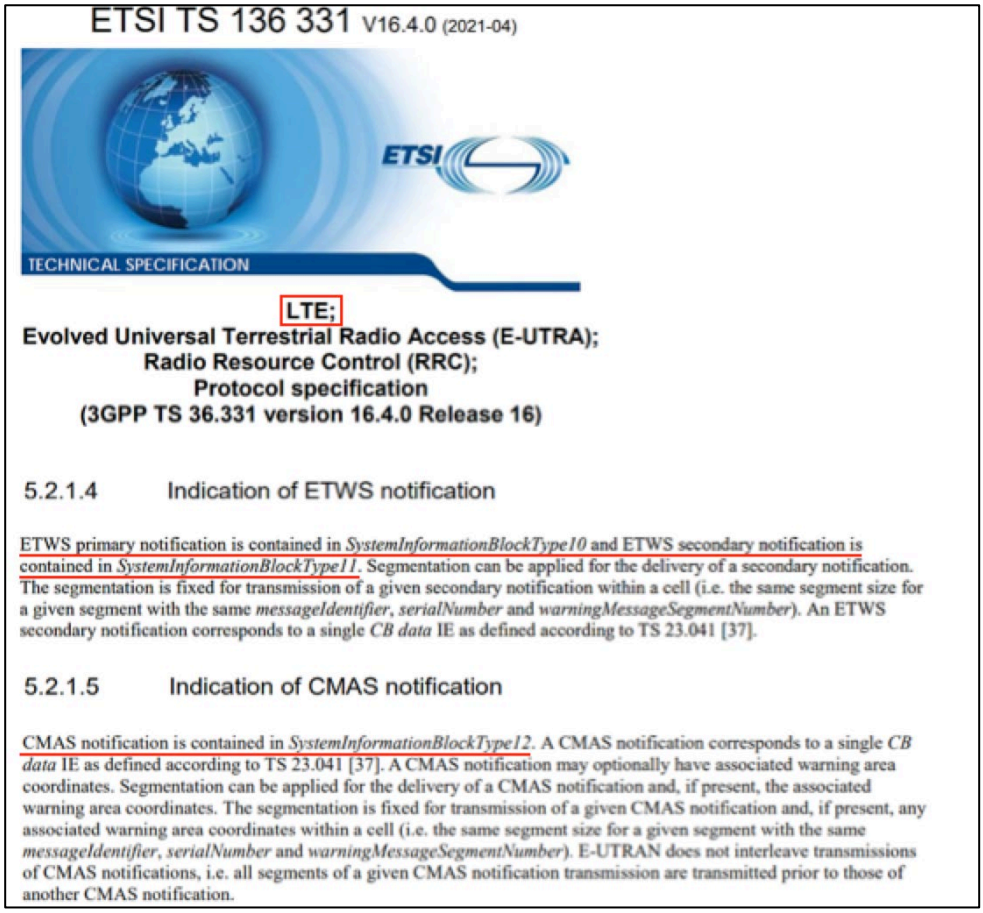


Fig 1: Basic CBS Architecture

The CBE is the messaging interface to the CBC. The CBE is a user interface used by the message creator to both compile the message and then specify the location (or locations) of message recipients. Once defined, the message is sent to the CBC, which maps the target area to the mobile network cells and then sends the cell broadcast message to the required radio access network(GSM, 3G, LTE), which will manage the message broadcast to the end user[15].



ETSI TS 136 331 V16.4.0 (2021-04)

TECHNICAL SPECIFICATION

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Radio Resource Control (RRC);
Protocol specification
(3GPP TS 36.331 version 16.4.0 Release 16)

5.2.1.4 Indication of ETWS notification

ETWS primary notification is contained in *SystemInformationBlockType10* and ETWS secondary notification is contained in *SystemInformationBlockType11*. Segmentation can be applied for the delivery of a secondary notification. The segmentation is fixed for transmission of a given secondary notification within a cell (i.e. the same segment size for a given segment with the same *messageIdentifier*, *serialNumber* and *warningMessageSegmentNumber*). An ETWS secondary notification corresponds to a single *CB data* IE as defined according to TS 23.041 [37].

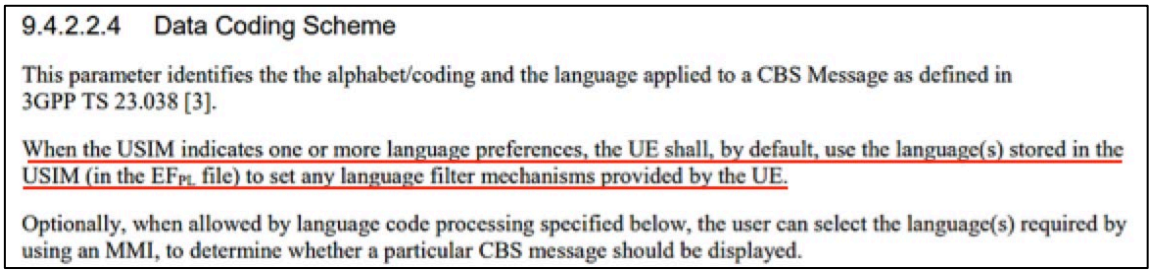
5.2.1.5 Indication of CMAS notification

CMAS notification is contained in *SystemInformationBlockType12*. A CMAS notification corresponds to a single *CB data* IE as defined according to TS 23.041 [37]. A CMAS notification may optionally have associated warning area coordinates. Segmentation can be applied for the delivery of a CMAS notification and, if present, the associated warning area coordinates. The segmentation is fixed for transmission of a given CMAS notification and, if present, any associated warning area coordinates within a cell (i.e. the same segment size for a given segment with the same *messageIdentifier*, *serialNumber* and *warningMessageSegmentNumber*). E-UTRAN does not interleave transmissions of CMAS notifications, i.e. all segments of a given CMAS notification transmission are transmitted prior to those of another CMAS notification.

32. Regarding claim 10:

The mobile terminal according to claim 8, wherein said hardware memory area of the mobile terminal comprises a Subscription Identity Module of the mobile terminal or any other hardware memory area of the mobile terminal.

For example, but not by way of limitation, the LG K92 includes a SIM that stores a language preference of the user.



9.4.2.2.4 Data Coding Scheme

This parameter identifies the the alphabet/coding and the language applied to a CBS Message as defined in 3GPP TS 23.038 [3].

When the USIM indicates one or more language preferences, the UE shall, by default, use the language(s) stored in the USIM (in the EF_{PL} file) to set any language filter mechanisms provided by the UE.

Optionally, when allowed by language code processing specified below, the user can select the language(s) required by using an MMI, to determine whether a particular CBS message should be displayed.

33. Emergent Mobile has been damaged by the direct infringement of LG and is suffering and will continue to suffer irreparable harm and damages as a result of this infringement.

COUNT II – Infringement of United States Patent No. 9,198,014

34. Plaintiff hereby realleges paragraphs 1 through 27 as though fully set forth herein.

35. LG directly and/or through its subsidiaries, affiliates, agents, and/or business partners, have in the past and continue to directly infringe at least claim 1 of the '014 Patent pursuant to 35 U.S.C. § 271(a) by making, using, selling, offering for sale, and/or importing in the United States (the "'014 Accused Products.)

36. LG products that infringe one or more claims of the '014 patent include, but are not limited to, 4G and 5G phones and smartphones, including but not limited to the LG W series, LG Velvet series, LG K series, LG Q series, LG V series, LG G series, LG X, LG Signature Edition Series, LG Stylo series, LG Wing, series and the like. [2]

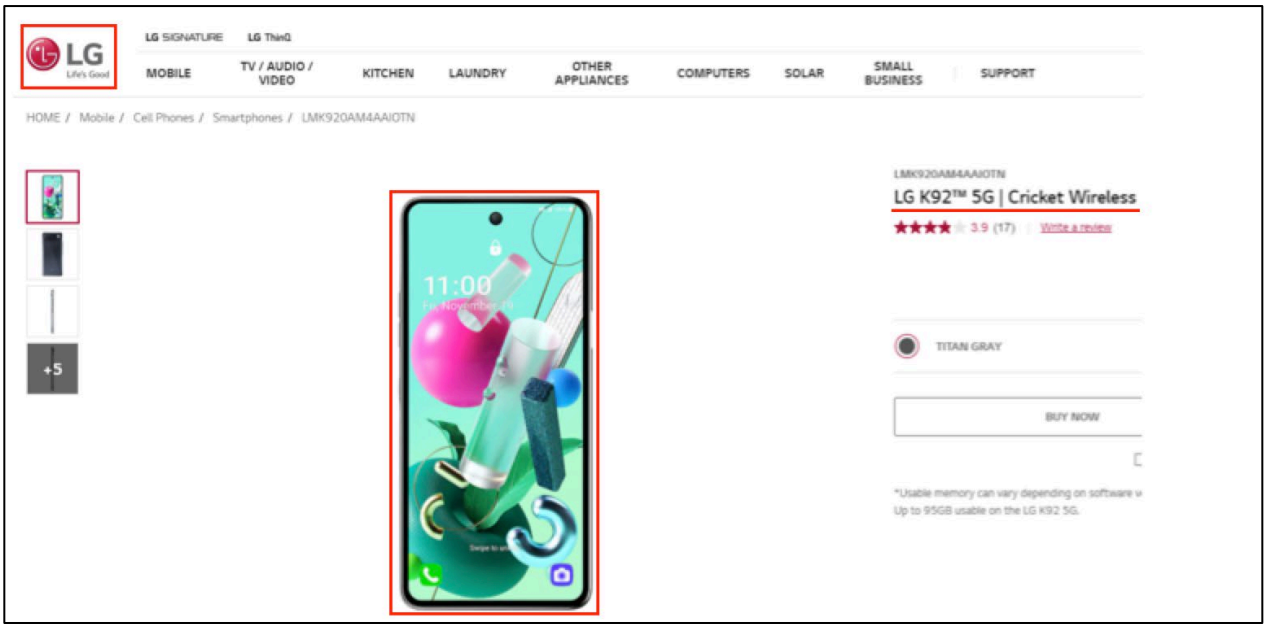
37. Regarding claim 1:

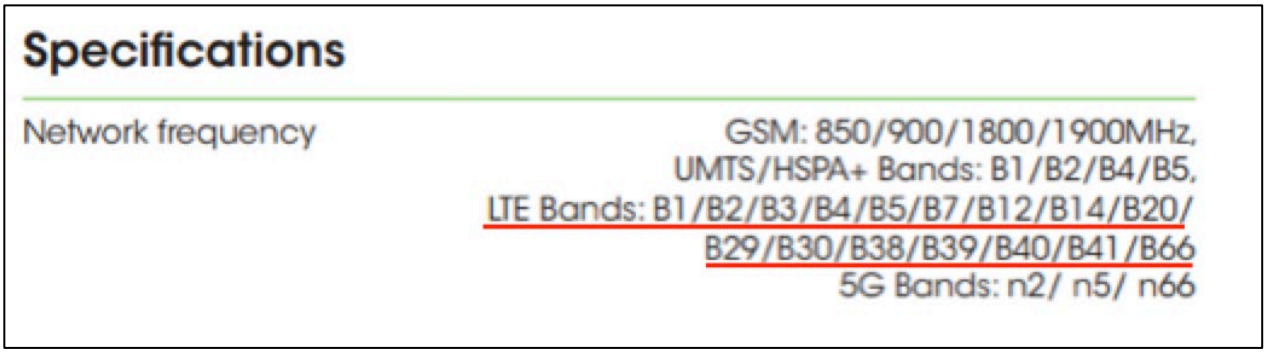
A process for transmitting at least one alarm signal from an alarmed apparatus to a PSAP, or Public Safety Answering Point, through a system composed of a plurality of cooperating apparatuses, the alarmed apparatus included in the plurality of cooperating apparatuses.

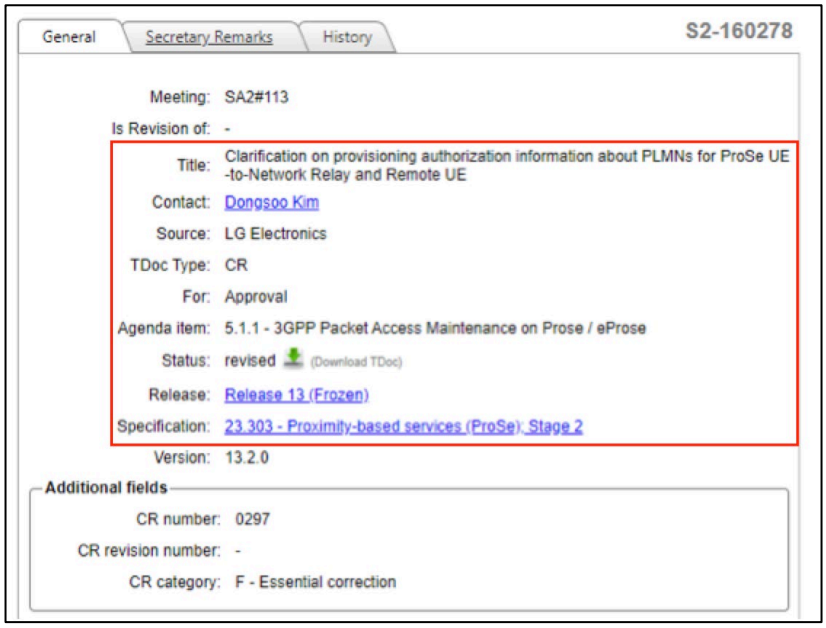
For example, but not by way of limitation, the '014 Accused Products, such as the LG K92 support the LTE network and LTE standard specification (i.e., 3GPP TS 23.468 version 15.0) which delineates technical realization of a Group Communication Service (GCS) which corresponds to a process for transmitting at least one alarm signal from a user equipment of UE

[2] Plaintiff reserves the right to add additional infringing devices for its infringement contentions.

(i.e., "alarmed apparatus") to a Group Communication Service Application Server (i.e., "Public Safety Answering Point"). The alarm signal can be transmitted from a ProSe enabled UE to another ProSe enabled UE through a ProSe UE-to-network relay which corresponds to a system composed of a plurality of cooperating apparatuses. Further, LG has provided contributions to the LTE standard specification 3GPP TS 23.303 – Proximity based services (ProSe) specifically pertaining to provisioning authorization information about PLMNs for ProSe UE-to-Network Relay and Remote UE.







General | Secretary Remarks | History — S2-160278

Meeting:	SA2#113
Is Revision of:	-
Title:	Clarification on provisioning authorization information about PLMNs for ProSe UE -to-Network Relay and Remote UE
Contact:	Dongsoo Kim
Source:	LG Electronics
TDoc Type:	CR
For:	Approval
Agenda item:	5.1.1 - 3GPP Packet Access Maintenance on Prose / eProse
Status:	revised (Download TDoc)
Release:	Release 13 (Frozen)
Specification:	23.303 - Proximity-based services (ProSe); Stage 2
Version:	13.2.0

Additional fields

CR number:	0297
CR revision number:	-
CR category:	F - Essential correction

LTE;
Group Communication System Enablers for LTE (GCSE_LTE);
Stage 2
(3GPP TS 23.468 version 15.0.0 Release 15)

4.2.4 Architecture model using a ProSe UE-to-Network Relay for Public Safety

A Group Communication Service (GCS) is supported to the Remote UE using the ProSe UE-to-Network Relay through the PC5 reference point specified in TS 23.303 [11]. In Figure 4.2.4-1, the architecture includes this scenario. This architecture is only applied when using a Group Communication Service Application Server (GCS AS) for public safety.

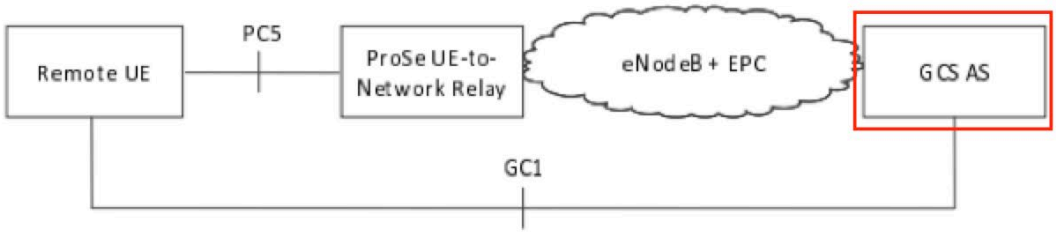


Figure 4.2.4-1: Architecture model using a ProSe UE-to-Network Relay for Public Safety

ETSI TS 123 303 V15.1.0 (2018-07)

Universal Mobile Telecommunications System (UMTS);
LTE;
Proximity-based services (ProSe);
Stage 2
(3GPP TS 23.303 version 15.1.0 Release 15)

1 Scope

ProSe Direct Communication enables establishment of communication paths between two or more ProSe-enabled UEs that are in direct communication range. The ProSe Direct Communication path could use E-UTRAN or WLAN.

For Public Safety specific usage:

- ProSe-enabled Public Safety UEs can establish the communication path directly between two or more ProSe-enabled Public Safety UEs, regardless of whether the ProSe-enabled Public Safety UE is served by E-UTRAN.
- ProSe Direct Communication is also facilitated by the use of a ProSe UE-to-Network Relay, which acts as a relay between E-UTRAN and UEs.

3.1 Definitions

ProSe-enabled Public Safety UE: A UE that the HPLMN has configured to be authorized for Public Safety use, and which is ProSe-enabled and supports ProSe procedures and capabilities specific to Public Safety. The UE may, but need not, have a USIM with one of the special access classes {12, 13, 14}.

Remote UE: A ProSe-enabled Public Safety UE that communicates with a PDN via a ProSe UE-to-Network Relay.

4.4.3 ProSe UE-to-Network Relay for Public Safety

The ProSe UE-to-Network Relay entity provides the functionality to support connectivity to the network for Remote UEs (see figure 4.4.3-1).

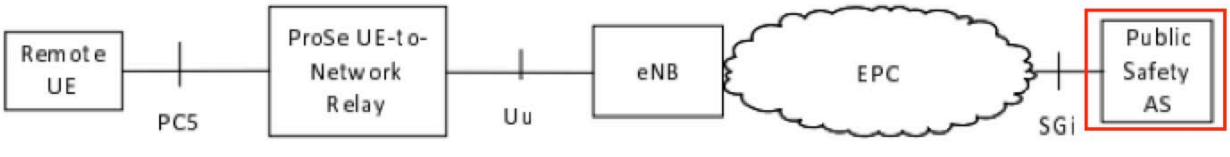


Figure 4.4.3-1: Architecture model using a ProSe UE-to-Network Relay

said apparatuses being equipped at least with memory means, processing means and a first radio system for direct reception/transmission, from apparatus to apparatus, of signals and data,

The ProSe-enabled Public Safety UE supports one-to-one and one-to-many direct communications over PC5 reference point which corresponds to a first radio system using pre-configured or stored parameters.

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4.4 Functional Entities

4.4.2 UE

Any ProSe-enabled UE may support the following functions:

- Exchange of ProSe control information between ProSe-enabled UE and the ProSe Function over PC3 reference point.
- Procedures for open and restricted ProSe Direct Discovery of other ProSe-enabled UEs over PC5 reference point.

The ProSe-enabled Public Safety UE may support the following functions:

- Procedures for one-to-many ProSe Direct Communication over PC5 reference point.
- Procedures for one-to-one ProSe Direct Communication over PC5 reference point.
- Procedures to act as a ProSe UE-to-Network Relay. The Remote UE communicates with the ProSe UE-to-Network Relay over PC5 reference point. The Prose UE-to-Network Relay uses layer-3 packet forwarding.
- Exchange of control information between ProSe-UEs over PC5 reference point, e.g. for UE-to-Network Relay Discovery and Group Member Discovery.
- Exchange of ProSe control information between another ProSe-enabled UE and the ProSe Function over PC3 reference point. In the ProSe UE-to-Network Relay case the Remote UE will send this control information over PC5 user plane to be relayed over the LTE-Uu interface towards the ProSe Function.
- Configuration of parameters (e.g. including IP addresses, ProSe Layer-2 Group IDs, Group security material, radio resource parameters). These parameters can be pre-configured in the UE, or, if in coverage, provisioned by signalling over the PC3 reference point to the ProSe Function in the network.

4.3 Reference points

4.3.1 List of Reference Points

PC5: The reference point between ProSe-enabled UEs used for control and user plane for ProSe Direct Discovery, ProSe Direct Communication and ProSe UE-to-Network Relay. The lower protocol layers of the PC5 reference point can be based on E-UTRA sidelink capabilities specified in TS 36.300 [17] or on WLAN technology.

3.1 Definitions

ProSe Direct Communication: A communication between two or more UEs in proximity that are ProSe-enabled, by means of user plane transmission using E-UTRA technology via a path not traversing any network node.

ProSe Direct Discovery: A procedure employed by a ProSe-enabled UE to discover other ProSe-enabled UEs in its vicinity by using only the capabilities of the two UEs with E-UTRA or WLAN technology.

wherein at least one apparatus included in the plurality of cooperating apparatuses is equipped with means for transmitting said alarm signal to said PSAP, the process comprising the steps of:

The 3GPP TS 23.308 version 15.1 describes that the ProSe UE-to-Network Relay entity supports connectivity to the network for Remote UEs and Public Safety Application Server (i.e., "PSAP").

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3.1 Definitions

ProSe UE-to-Network Relay: A UE that provides functionality to support connectivity to the network for Remote UE(s).

1 Scope

For Public Safety specific usage:

- ProSe-enabled Public Safety UEs can establish the communication path directly between two or more ProSe-enabled Public Safety UEs, regardless of whether the ProSe-enabled Public Safety UE is served by E-UTRAN.
- ProSe Direct Communication is also facilitated by the use of a ProSe UE-to-Network Relay, which acts as a relay between E-UTRAN and UEs.

4.4.3 ProSe UE-to-Network Relay for Public Safety

The ProSe UE-to-Network Relay entity provides the functionality to support connectivity to the network for Remote UEs (see figure 4.4.3-1).

A UE is considered to be a Remote UE for a certain ProSe UE-to-Network relay if it has successfully established a PC5 link to this ProSe UE-to-Network Relay. A Remote UE can be located within E-UTRAN coverage or outside of E-UTRAN coverage.

NOTE 1: If a Remote UE maintains both PC5 and Uu, the EPS core network entities on the Uu side of the Remote UE are not aware of the ProSe UE-to-Network Relay path via PC5.

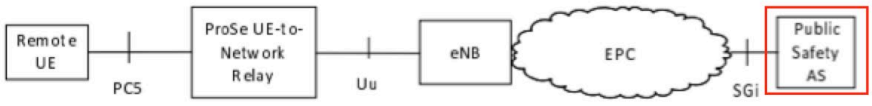

Figure 4.4.3-1: Architecture model using a ProSe UE-to-Network Relay

The ProSe UE-to-Network Relay shall relay unicast traffic (UL and DL) between the Remote UE and the network. The ProSe UE-to-Network Relay shall provide generic function that can relay any IP traffic.

NOTE 2: IP Address preservation is not supported.

One-to-one Direct Communication is used between Remote UEs and ProSe UE-to-Network Relays for unicast traffic as specified in clause 5.4.5.

The ProSe UE-to-Network Relay may also relay eMBMS traffic using one-to-many ProSe Direct Communication as specified in clause 5.4.4.4.

a) embedding said alarm signal into at least one exploring signal radiated in the first instance from said alarmed apparatus through said first radio system,

The remote UE sends a UE-to-Network Relay Discovery solicitation message (i.e., exploring signal) including a Relay Service Code (i.e., "alarm signal") for identifying a connectivity service.

ETSI TS 124 334 V15.2.0 (2018-10)

Universal Mobile Telecommunications System (UMTS);
LTE;
Proximity-services (ProSe)
User Equipment (UE)
to ProSe function protocol aspects;
Stage 3
(3GPP TS 24.334 version 15.2.0 Release 15)

10A.2.4 Discoverer UE procedure for UE-to-network relay discovery

10A.2.4.1 General

The purpose of the discoverer UE procedure for UE-to-network relay discovery is:

- to enable a ProSe-enabled public safety UE to solicit proximity of a connectivity service provided by a UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.303 [2]; or
- to enable a ProSe-enabled public safety UE to measure the PC5_DISCOVERY message signal strength between the ProSe-enabled public safety UE and the ProSe UE-to-network relay UE(s) for relay selection/reselection.

5.3.7 Direct Discovery for Public Safety use

5.3.7.1 General

The following functions for public safety direct discovery are supported:

- UE-to-Network Relay Discovery.
- Determination is needed regarding within the ProSe Communication which user(s) are in ProSe Communication range at any given time (shortly referred to as "Group Member Discovery").

UE-to-Network Relay Discovery involves the use of pre-provisioned parameters to first discover a UE-to-Network Relay, and a subsequent communication link establishment. This makes the overall discovery procedure as restricted type, in that only Remote UEs with valid credentials and some form of pre-affiliation are able to successfully complete the overall procedure.

Public Safety discovery for ProSe UE-to-Network Relay Discovery and Group Member Discovery uses the PC5-D protocol stack that is depicted in Figure 5.1.1.5-1.

Both Model A and Model B discovery are supported:

- Model A uses a single discovery protocol message (Announcement).
- Model B uses two discovery protocol messages (Solicitation and Response).

Depicted in Figure 5.3.7.1-2 is the procedure for public safety direct discovery with Model B.

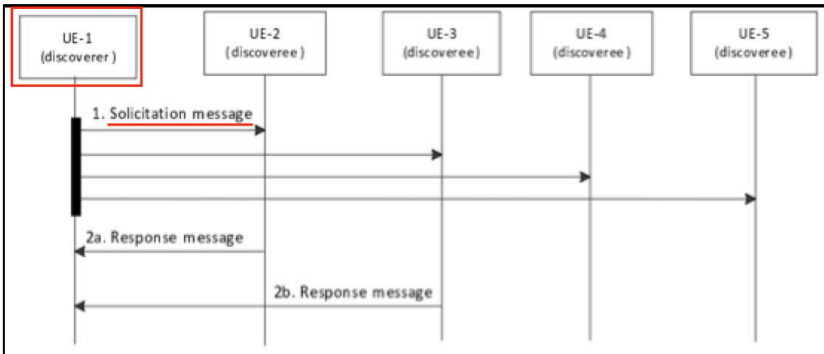

Figure 5.3.7.1-2: Public safety direct discovery with Model B

For UE-to-Network Relay Discovery:

1. The Remote UE sends a UE-to-Network Relay Discovery Solicitation message. The parameters contained in this message are described in clause 4.6.4.3.
2. The ProSe UE-to-Network Relays that match the values of the Relay Service Code contained in the solicitation message respond to the Remote UE with a UE-to-Network Relay Discovery Response message. The parameters contained in this message are described in clause 4.6.4.3.

4.6.4.3 Identifiers for ProSe UE-to-Network Relay discovery and selection

The following parameters are used in the UE-to-Network Relay Discovery Solicitation message (Model B):

- Discoverer Info: provides information about the discoverer user.
- Relay Service Code: information about connectivity that the discoverer UE is interested in. The Relay Service Codes are configured in the Remote UEs interested in related connectivity services.
- ProSe Relay UE ID: link layer identifier of a UE-to-Network Relay that is used for direct communication and is associated with a Relay Service Code. A UE-to-Network Relay shall have a distinct ProSe Relay UE ID for each Relay Service Code. The ProSe Relay UE ID is optional.

3.1 Definitions

Relay Service Code: A Relay Service Code is used to identify a connectivity service the ProSe UE-to-Network Relay provides, and the authorized users the ProSe UE-to-Network Relay would offer service to, and may select the related security policies or information e.g. necessary for authentication and authorization between the Remote UE and the ProSe UE-to-Network Relay. The definition of values of Relay Service Code is out of scope of this specification.

wherein said exploring signal induces acknowledgement responses from the apparatuses picking up said exploring signal, regardless of whether the alarmed apparatus is aware a priori of the presence or the existence of said apparatuses picking up said exploring signal, said first radio system being configures to receive said acknowledgement responses,

The discoveree UEs that receive the UE-to-Network Relay Discovery solicitation message (i.e., exploring signal) including the Relay Service Code (i.e., "alarm signal") send response message to the remote UE/discover using the PC5 interface.

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5.3.7 Direct Discovery for Public Safety use

5.3.7.1 General

Depicted in Figure 5.3.7.1-2 is the procedure for public safety direct discovery with Model B.

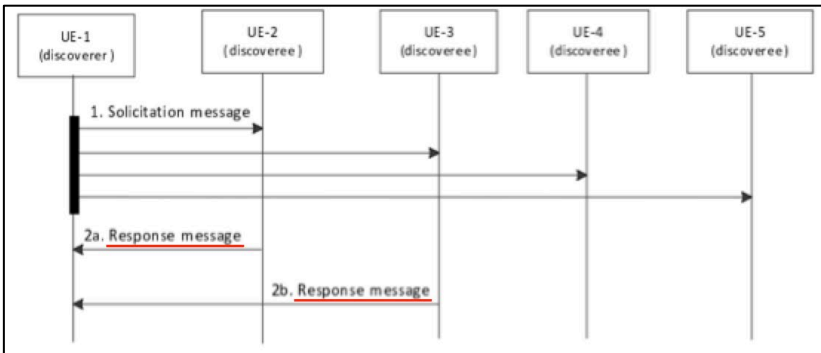


Figure 5.3.7.1-2: Public safety direct discovery with Model B

For UE-to-Network Relay Discovery:

1. The Remote UE sends a UE-to-Network Relay Discovery Solicitation message. The parameters contained in this message are described in clause 4.6.4.3.
2. The ProSe UE-to-Network Relays that match the values of the Relay Service Code contained in the solicitation message respond to the Remote UE with a UE-to-Network Relay Discovery Response message. The parameters contained in this message are described in clause 4.6.4.3.

4.6.4.3 Identifiers for ProSe UE-to-Network Relay discovery and selection

The following parameters are used in the UE-to-Network Relay Discovery Solicitation message (Model B):

- ProSe Relay UE ID: link layer identifier of a UE-to-Network Relay that is used for direct communication and is associated with a Relay Service Code. A UE-to-Network Relay shall have a distinct ProSe Relay UE ID for each Relay Service Code. The ProSe Relay UE ID is optional.

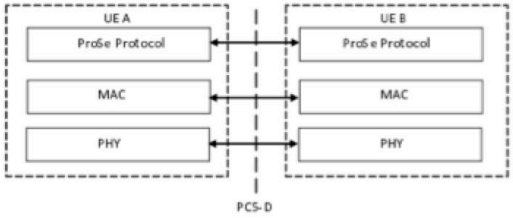
The following parameters are used in the UE-to-Network Relay Discovery Response message (Model B):

- ProSe Relay UE ID: link layer identifier that is used for direct communication and is associated with a Relay Service Code. A UE-to-Network Relay shall have a distinct ProSe Relay UE ID for each Relay Service Code.

NOTE: It is up to stage 3 specifications how the UE-to-Network Relay indicates in the response message which Relay Service Code it can support.

- Discoveree Info: provides information about the discoveree.

5.1.1.5.1 Discovery plane PC5 interface



Legend:
- **PC5-D:** The MAC/PHY functionality for E-UTRA based PC5 is specified in TS 36.300 [17].
- The "ProSe protocol" is used for handling ProSe Direct Discovery specified in TS 24.334 [24].

Figure 5.1.1.5.1-1: Discovery Plane PC5 Interface

and said apparatuses picking up said exploring signal being eligible for, based on said acknowledgement responses, being added to said plurality of cooperating apparatuses;

The remote UE selects a suitable ProSe UE-to-Network relay UE based on the responses received from the discoveree UEs to establish network connectivity.

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10A.2.12UE-to-network relay selection procedure

10A.2.12.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable ProSe UE-to-network relay UE to obtain a connectivity service to EPC.

10A.2.12.2 UE-to-network relay selection procedure initiation

The remote UE shall trigger the UE-to-network relay selection procedure if the following conditions are met:

- the UE is authorised to act as a remote UE towards a ProSe UE-to-network relay UE as specified in clause 5;
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling ProSe layer criteria with the monitoring procedure for UE-to-network relay discovery as specified in subclause 10A.2.3 or the discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4; and
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 36.331 [12].

10A.2.12.3 UE-to-network relay selection procedure completion

If there exists only one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, then that ProSe UE-to-network relay UE is selected. If there exist more than one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, any relay candidates not satisfying the non-radio related ProSe layer criteria shall be discarded, and out of the remaining relay candidates, the relay candidate with the highest ranking of the lower layer criteria shall be selected. The UE may take the value of the Resource Status Indicator bit of the Status Indicator parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement or PC5_DISCOVERY message for UE-to-Network Relay Discovery Response into account when deciding which ProSe UE-to-network relay to select. It is up to the UE implementation whether the ProSe layer or the lower layers takes the final selection on which ProSe UE-to-network relay UE to select.

12.2.2.67 Status Indicator

This parameter is used to indicate the status of ProSe UE-to-network relay.

This parameter is coded as shown in figure 12.2.2.67.1 and table 12.2.2.67.1.

Resource Status Indicator (RSI) is used to indicate whether or not the UE has resources available to provide a connectivity service for additional ProSe-enabled public safety UEs.

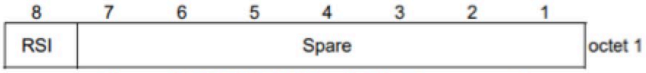

Figure 12.2.2.67.1: Status Indicator parameter

Table 12.2.2.67.1: Status Indicator parameter

RSI (octet 1) Bit 8	
0	the UE does not have resources available to provide a connectivity service for additional ProSe-enabled public safety UEs
1	the UE has resources available to provide a connectivity service for additional ProSe-enabled public safety UEs
Bits 1 to 7 of octet 1 are spare and shall be coded as zero (see NOTE).	
NOTE: Bits 1 to 7 of octet 1 were reserved in earlier versions of the protocol.	

10A.2.4.2 Discoverer UE procedure for UE-to-network relay discovery initiation

Upon reception of a PC5_DISCOVERY message for UE-to-Network Relay Discovery Response according to subclause 11.2.5.1, for the target Relay Service Code of the connectivity service which the UE is authorized to discover, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for UE-to-Network Relay Discovery Response.

Then if:

- the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation; and
- the User Info ID of the UE-to-network relay is not configured as specified in clause 5 for the connectivity service being solicited, or the Discoverer Info parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the User Info ID of the UE-to-network relay configured as specified in clause 5 for the connectivity service being solicited;

then the UE shall consider that the connectivity service the UE seeks to discover has been discovered. In addition, the UE can measure the signal strength of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response for relay selection or reselection. If the UE has received the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response from the ProSe UE-to-network relay UE with which the UE has a link established, the UE shall stop the retransmission timer T4109, and start the periodic measurement timer T4110.

b) having at least one of said cooperating apparatuses which may have received said exploring signal receive and transmit said exploring signal such that said exploring signal is received and transmitted from cooperating apparatus to cooperating apparatus until at least one of said cooperating apparatuses that have directly or indirectly receive said exploring signal transmits said alarm signal to said PSAP though said means for transmitting said alarm signal to said PSAP,

The ProSe UE-to-Network relay UE provides connectivity to the network for remote UEs to enable Public Safety.

ETSI TS 122 278 V15.4.0 (2018-10)

LTE;

Service requirements for the Evolved Packet System (EPS)

(3GPP TS 22.278 version 15.4.0 Release 15)

3 Definitions and abbreviations

3.1 Definitions

ProSe UE-to-UE Relay: is a form of relay in which a Public Safety ProSe-enabled UE acts as a ProSe E-UTRA Communication relay between two other Public Safety ProSe-enabled UEs.

7A.2 Public Safety Specific Requirements for Proximity Services

An authorised Public Safety ProSe-enabled UE shall be capable of acting as a relay for ProSe E-UTRA Communication between two Public Safety ProSe-enabled UEs, ProSe Broadcast Communication, and ProSe Group Communication.

A ProSe UE-to-UE Relay shall be capable of relaying communications for one or more Public Safety ProSe-enabled UEs that are within Communication Range of the ProSe UE-to-UE Relay.

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4.4.3 ProSe UE-to-Network Relay for Public Safety

The ProSe UE-to-Network Relay entity provides the functionality to support connectivity to the network for Remote UEs (see figure 4.4.3-1).

A UE is considered to be a Remote UE for a certain ProSe UE-to-Network relay if it has successfully established a PC5 link to this ProSe UE-to-Network Relay. A Remote UE can be located within E-UTRAN coverage or outside of E-UTRAN coverage.

NOTE 1: If a Remote UE maintains both PC5 and Uu, the EPS core network entities on the Uu side of the Remote UE are not aware of the ProSe UE-to-Network Relay path via PC5.

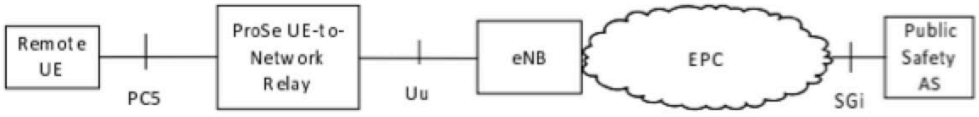

Figure 4.4.3-1: Architecture model using a ProSe UE-to-Network Relay

wherein said exploring signal is re-transmitted by at least one selected cooperating apparatus upon receiving a command issued by said alarmed apparatus wherein said at least one selected cooperating apparatus is selected depending on acknowledgments transmitted by said cooperating apparatuses to said alarmed apparatus about a result of a reception of said exploring signal by at least one of said cooperating apparatuses and about a result of a tentative re-transmission of said alarm signal to said PSAP.

The remote UE can trigger the UE-to-Network relay reselection procedure based on measured signal strength of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response, the UE receiving a DIRECT_COMMUNICATION_REJECT message from the ProSe UE-to-Network relay UE, for relay selection or reselection or the UE receiving a DIRECT_COMMUNICATION_RELEASE message from the ProSe UE-to-Network relay UE.

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4.4.3 ProSe UE-to-Network Relay for Public Safety

The ProSe UE-to-Network Relay entity provides the functionality to support connectivity to the network for Remote UEs (see figure 4.4.3-1).

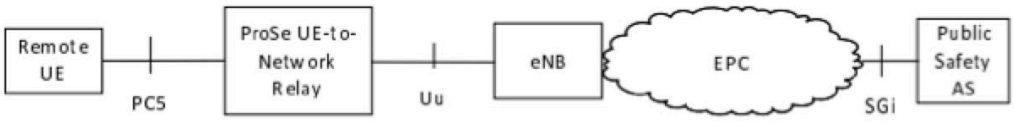

Figure 4.4.3-1: Architecture model using a ProSe UE-to-Network Relay

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10A.2.4 Discoverer UE procedure for UE-to-network relay discovery

10A.2.4.1 General

The purpose of the discoverer UE procedure for UE-to-network relay discovery is:

- to enable a ProSe-enabled public safety UE to solicit proximity of a connectivity service provided by a UE-to-network relay, upon a request from upper layers as defined in 3GPP TS 23.303 [2]; or
- to enable a ProSe-enabled public safety UE to measure the PC5_DISCOVERY message signal strength between the ProSe-enabled public safety UE and the ProSe UE-to-network relay UE(s) for relay selection/reselection.

10A.2.12UE-to-network relay selection procedure

10A.2.12.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable ProSe UE-to-network relay UE to obtain a connectivity service to EPC.

10A.2.12.2 UE-to-network relay selection procedure initiation

The remote UE shall trigger the UE-to-network relay selection procedure if the following conditions are met:

- the UE is authorised to act as a remote UE towards a ProSe UE-to-network relay UE as specified in clause 5;
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling ProSe layer criteria with the monitoring procedure for UE-to-network relay discovery as specified in subclause 10A.2.3 or the discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4; and
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 36.331 [12].

10A.2.12.3 UE-to-network relay selection procedure completion

If there exists only one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, then that ProSe UE-to-network relay UE is selected. If there exist more than one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, any relay candidates not satisfying the non-radio related ProSe layer criteria shall be discarded, and out of the remaining relay candidates, the relay candidate with the highest ranking of the lower layer criteria shall be selected. The UE may take the value of the Resource Status Indicator bit of the Status Indicator parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement or PC5_DISCOVERY message for UE-to-Network Relay Discovery Response into account when deciding which ProSe UE-to-network relay to select. It is up to the UE implementation whether the ProSe layer or the lower layers takes the final selection on which ProSe UE-to-network relay UE to select.

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10A.2.12UE-to-network relay selection procedure

10A.2.12.1 General

The purpose of the UE-to-network relay selection procedure is to enable a remote UE to select a suitable ProSe UE-to-network relay UE to obtain a connectivity service to EPC.

10A.2.12.2 UE-to-network relay selection procedure initiation

The remote UE shall trigger the UE-to-network relay selection procedure if the following conditions are met:

- the UE is authorised to act as a remote UE towards a ProSe UE-to-network relay UE as specified in clause 5;
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling ProSe layer criteria with the monitoring procedure for UE-to-network relay discovery as specified in subclause 10A.2.3 or the discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4; and
- the UE has obtained a list of ProSe UE-to-network relay UE candidate(s) fulfilling lower layers criteria as specified in 3GPP TS 36.331 [12].

10A.2.12.3 UE-to-network relay selection procedure completion

If there exists only one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, then that ProSe UE-to-network relay UE is selected. If there exist more than one ProSe UE-to-network relay candidate satisfying the conditions in subclause 10A.2.12.2, any relay candidates not satisfying the non-radio related ProSe layer criteria shall be discarded, and out of the remaining relay candidates, the relay candidate with the highest ranking of the lower layer criteria shall be selected. The UE may take the value of the Resource Status Indicator bit of the Status Indicator parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Announcement or PC5_DISCOVERY message for UE-to-Network Relay Discovery Response into account when deciding which ProSe UE-to-network relay to select. It is up to the UE implementation whether the ProSe layer or the lower layers takes the final selection on which ProSe UE-to-network relay UE to select.

10A.2.4.2 Discoverer UE procedure for UE-to-network relay discovery initiation

Upon reception of a PC5_DISCOVERY message for UE-to-Network Relay Discovery Response according to subclause 11.2.5.1, for the target Relay Service Code of the connectivity service which the UE is authorized to discover, the UE shall use the associated DUSK, if configured, and the UTC-based counter obtained during the reception operation to unscramble the PC5_DISCOVERY message as described in 3GPP TS 33.303 [6]. Then, if a DUCK is configured, the UE shall use the DUCK and the UTC-based counter to decrypt the configured message-specific confidentiality-protected portion, as described in 3GPP TS 33.303 [6]. Finally, if a DUIK is configured, the UE shall use the DUIK and the UTC-based counter to verify the MIC field in the unscrambled PC5_DISCOVERY message for UE-to-Network Relay Discovery Response.

Then if:

- the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the Relay Service Code parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation; and
- the User Info ID of the UE-to-network relay is not configured as specified in clause 5 for the connectivity service being solicited, or the Discoverer Info parameter of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response is the same as the User Info ID of the UE-to-network relay configured as specified in clause 5 for the connectivity service being solicited;

then the UE shall consider that the connectivity service the UE seeks to discover has been discovered. In addition, the UE can measure the signal strength of the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response for relay selection or reselection. If the UE has received the PC5_DISCOVERY message for UE-to-Network Relay Discovery Response from the ProSe UE-to-network relay UE with which the UE has a link established, the UE shall stop the retransmission timer T4109, and start the periodic measurement timer T4110.

10A.2.13UE-to-network relay reselection procedure

10A.2.13.1 General

The purpose of the UE-to-network relay reselection procedure is to enable a remote UE to reselect a ProSe UE-to-network relay UE to obtain a connectivity service to EPC when the serving ProSe UE-to-network relay UE is no longer suitable.

10A.2.13.2 UE-to-network relay reselection procedure initiation

The remote UE shall trigger the UE-to-network relay reselection procedure if one of the following conditions is met:

a) the UE has received a lower layers indication that the serving ProSe UE-to-network relay UE no longer fulfills the lower layers criteria as specified in 3GPP TS 36.331 [12];

b) the parameters related to ProSe UE-to-network relay in the ProSe direct discovery for public safety use service authorisation (e.g., Relay Service Code, User Info ID, etc.) have been updated and the serving ProSe UE-to-network relay UE no longer fulfills the conditions specified in subclause 10A.2.3;

c) the UE has received a DIRECT_COMMUNICATION_REJECT message from the ProSe UE-to-network relay UE with the cause value "Direct communication to target UE not allowed";

d) the UE has received a DIRECT_COMMUNICATION_RELEASE message from the ProSe UE-to-network relay UE with the cause value "Direct communication with the peer UE is no longer allowed";

e) the UE has received a DIRECT_COMMUNICATION_RELEASE message from the ProSe UE-to-network relay UE with the cause value "Direct connection is not available any more";

f) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of DIRECT COMMUNICATION SETUP or DIRECT COMMUNICATION KEEPALIVE messages; or

g) the UE has not received any response from the ProSe UE-to-network relay UE after M consecutive retransmissions of PC5_DISCOVERY message for UE-to-Network Relay Discovery Solicitation used to trigger the PC5_DISCOVERY message signal strength measurement between the UE and the ProSe UE-to-network relay UE with which the UE has a link established.

NOTE: The value of M is implementation specific and is less than or equal to the maximum number of retransmissions allowed for PC5 Signalling protocol.

In cases c) and d), the remote UE shall exclude the ProSe UE-to-network relay UE which sent the message specified in cases c) or d) from the UE-to-network relay reselection process described below.

To conduct UE-to-network relay reselection process, the UE shall first initiate one of the following procedures or both depending on UE's service authorisation for ProSe direct discovery for public safety use:

- monitoring procedure for UE-to-network relay discovery as specified in subclause 10A.2.3; or
- discoverer procedure for UE-to-network relay discovery as specified in subclause 10A.2.4.

After the execution of the above discovery procedure(s), the remote UE performs the UE-to-network relay selection procedure as specified in subclause 10A.2.3.

38. Emergent Mobile has been damaged by the direct infringement of LG, and is suffering and will continue to suffer irreparable harm and damages as a result of this infringement.

COUNT III - Infringement of United States Patent No. 9,097,530

39. The allegations set forth above are re-alleged and incorporated by reference as if they were set fully here.

40. LG directly and/or through its subsidiaries, affiliates, agents, and/or business partners, have in the past and continue to directly infringe at least claims 1, 2, 5, 6, 8, 15, 17, 18, and 20 of the ’530 Patent pursuant to 35 U.S.C. § 271(a) by making, using, selling, or offering to sell, and/or importing in the United States. (the “’530 Accused Products”.)

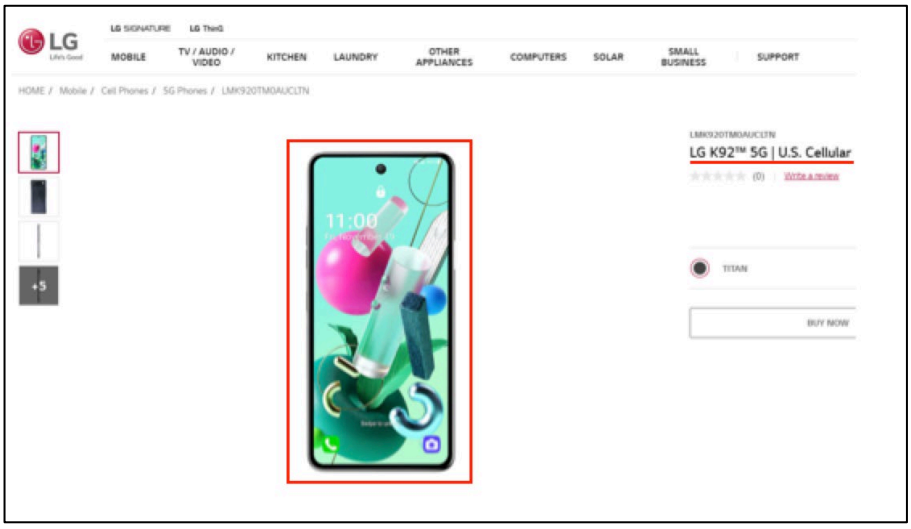
41. LG products that infringe one or more claims of the ’530 patent include, but are not limited to, 4G and 5G phones and smartphones which support ACcore, including but not limited

to the LG W series, LG Velvet series, LG K series, LG Q series, LG V series, LG G series, LG X series, LG Signature Edition Series, LG Stylo series, LG Wing, and the like. [3]

42. With regards to claim 1:

A personal navigation device for ensuring continuity of service in an event of insufficient reception of GNSS satellite signals, the device comprising:

For example, but not by way of limitation, the '530 Accused Products, such as the LG K92 has pre-installed Google Maps, and it supports Google ARCore. Google Maps' Live View feature enables a user to pinpoint the phone's location where GPS signal is weak or unavailable such as in indoor and in urban areas having tall buildings. Live View uses Google ARCore's motion tracking technology or localization technique to determine a device's location where GPS signal is weak. The localization technique uses visual inputs from the phone's camera and combines them with readings from the phone's inertial sensors to determine the phone's location.



[3] Plaintiff reserves the right to add additional infringing devices for its infringement contentions.

LG K92™ 5G

Google apps

Maps

Find your location or the location of a place on the map. View geographical information.

Use Live View on Google Maps

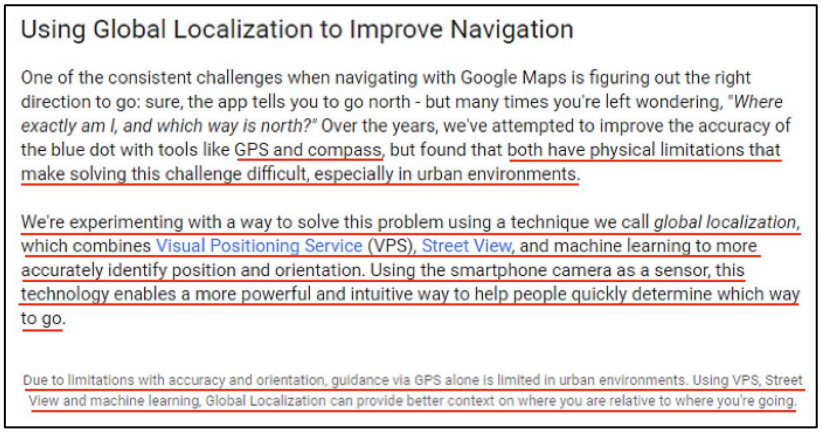
Discover and navigate places in the real world with the help of Live View.

Live View availability

- Your device must be compatible with ARKit/ARCore .

ARCore supported devices

Manufacturer	Device model
LG	K92



Using Global Localization to Improve Navigation

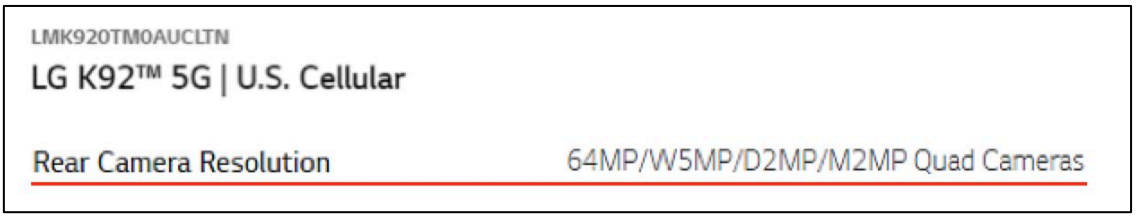
One of the consistent challenges when navigating with Google Maps is figuring out the right direction to go: sure, the app tells you to go north - but many times you're left wondering, *"Where exactly am I, and which way is north?"* Over the years, we've attempted to improve the accuracy of the blue dot with tools like GPS and compass, but found that both have physical limitations that make solving this challenge difficult, especially in urban environments.

We're experimenting with a way to solve this problem using a technique we call *global localization*, which combines Visual Positioning Service (VPS), Street View, and machine learning to more accurately identify position and orientation. Using the smartphone camera as a sensor, this technology enables a more powerful and intuitive way to help people quickly determine which way to go.

Due to limitations with accuracy and orientation, guidance via GPS alone is limited in urban environments. Using VPS, Street View and machine learning, Global Localization can provide better context on where you are relative to where you're going.

data input means for receiving first data from a user relating to a position of the personal navigation device; and

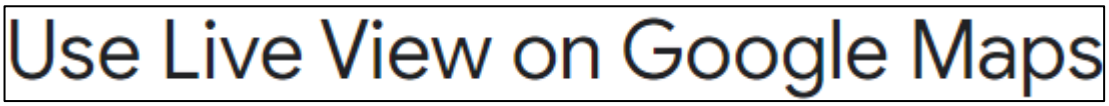
Defendant's LG K92 smartphone includes a rear camera (data input means). While using Live View Feature, a user needs to grant camera access to Live View and Live View asks the user to point the camera at buildings and signs so that Live View can identify current position of the phone using images captures by the camera (first data).



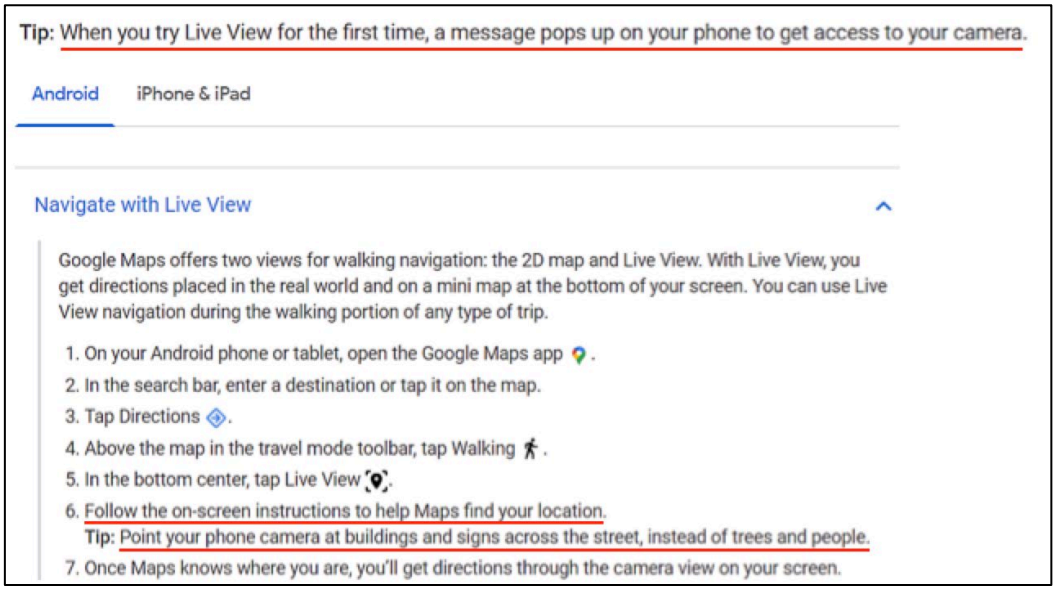
LMK920TM0AUCLTN

LG K92™ 5G | U.S. Cellular

Rear Camera Resolution	64MP/W5MP/D2MP/M2MP Quad Cameras



Use Live View on Google Maps



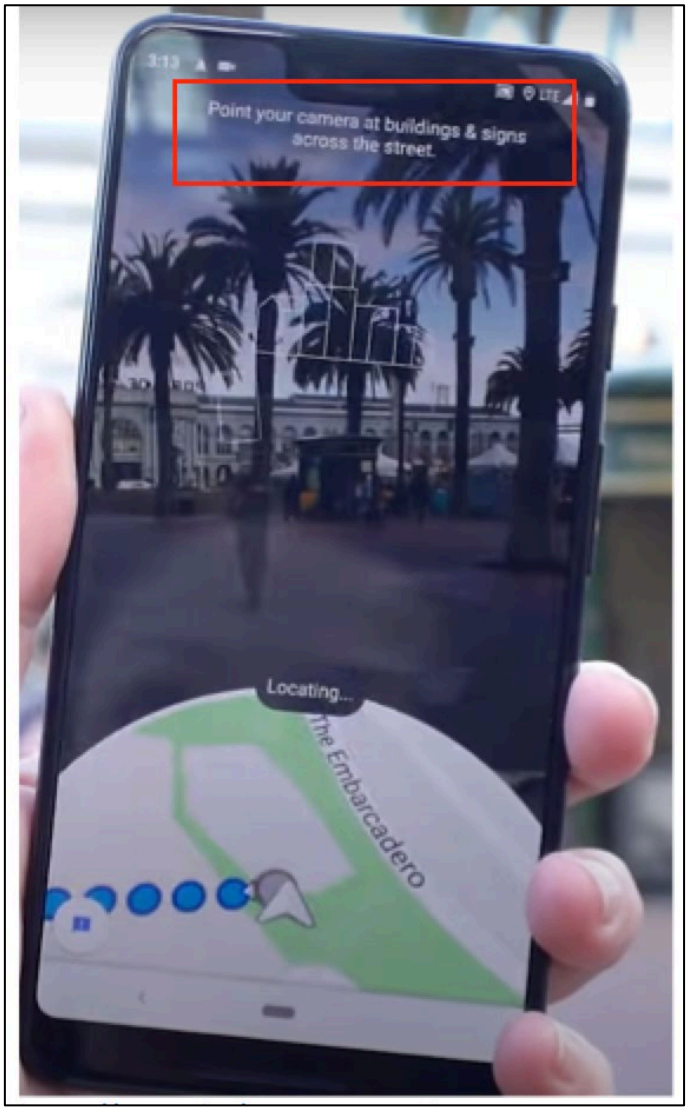
Tip: When you try Live View for the first time, a message pops up on your phone to get access to your camera.

Android iPhone & iPad

Navigate with Live View

Google Maps offers two views for walking navigation: the 2D map and Live View. With Live View, you get directions placed in the real world and on a mini map at the bottom of your screen. You can use Live View navigation during the walking portion of any type of trip.

1. On your Android phone or tablet, open the Google Maps app .
2. In the search bar, enter a destination or tap it on the map.
3. Tap Directions .
4. Above the map in the travel mode toolbar, tap Walking .
5. In the bottom center, tap Live View .
6. Follow the on-screen instructions to help Maps find your location.
   Tip: Point your phone camera at buildings and signs across the street, instead of trees and people.
7. Once Maps knows where you are, you'll get directions through the camera view on your screen.

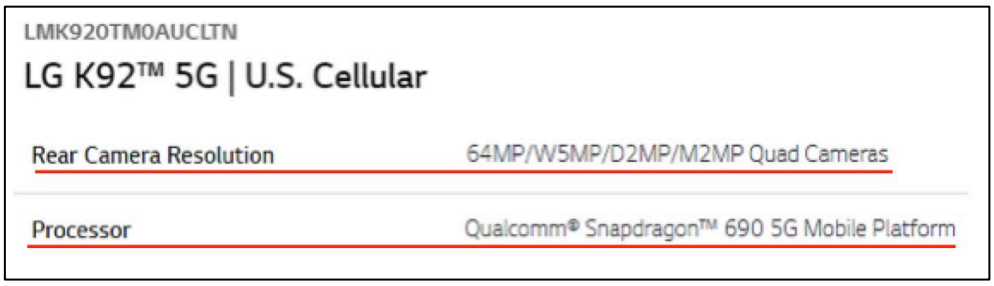


A New Approach to Localization

VPS determines the location of a device based on imagery rather than GPS signals. VPS first creates a map by taking a series of images which have a known location and analyzing them for key visual features, such as the outline of buildings or bridges, to create a large scale and fast searchable index of those visual features. To localize the device, VPS compares the features in imagery from the phone to those in the VPS index. However, the accuracy of localization through

a microprocessor connected to the data input means and associated with localization tools that generate second data related to the position of the personal navigation device,

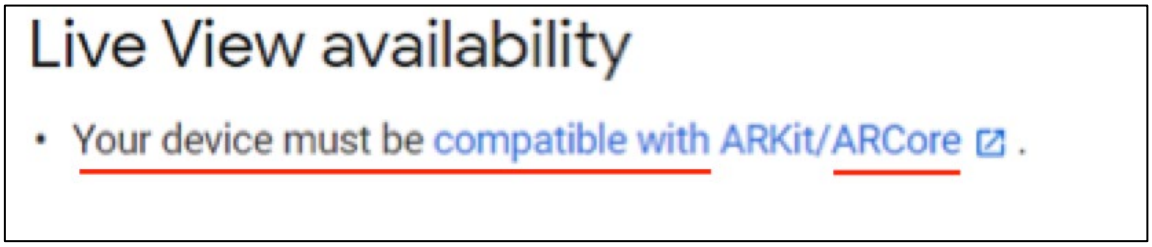
The LG K92 has a Qualcomm Snapdragon 690 processor, which is connected to the camera and inertial measurement units (IMU) sensors such as Accelerometer/Gyrometer/Magenetometer (localization tools). Live View uses the Google ARCore's localization technology in which a phone position and orientation is determined using input from the IMU sensors (second data).


LMK920TM0AUCLTN

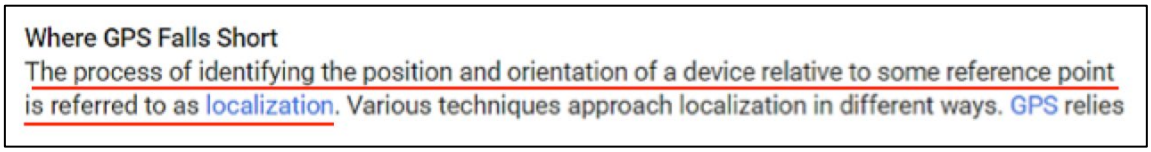
LG K92™ 5G | U.S. Cellular

Rear Camera Resolution	64MP/W5MP/D2MP/M2MP Quad Cameras
Processor	Qualcomm® Snapdragon™ 690 5G Mobile Platform

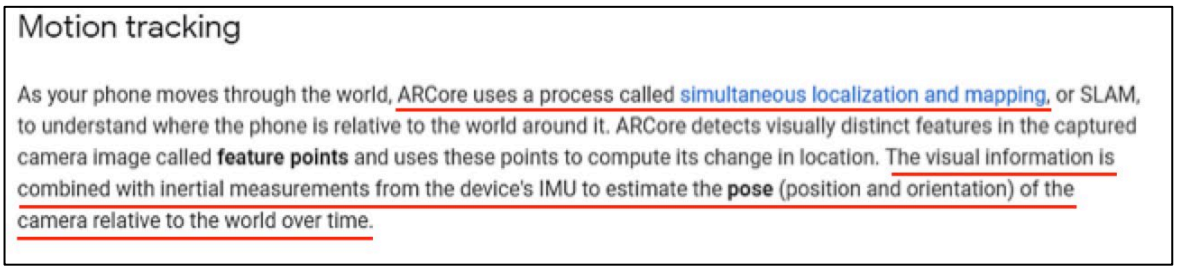

- **Sensors** – Gyroscope, Magnetometer, Accelerometer


Live View availability

- Your device must be compatible with ARKit/ARCore .


Where GPS Falls Short

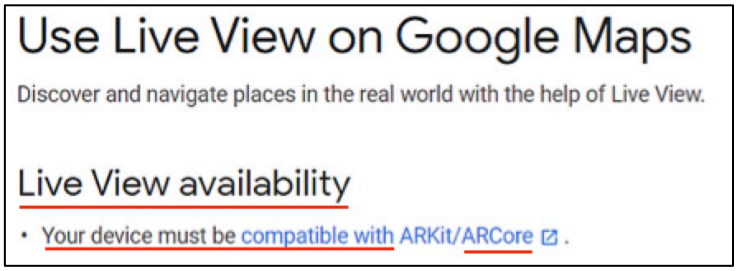
The process of identifying the position and orientation of a device relative to some reference point is referred to as localization. Various techniques approach localization in different ways. GPS relies

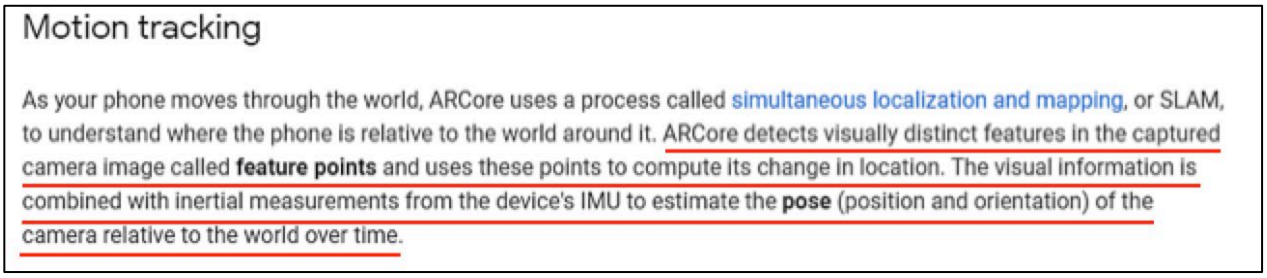

Motion tracking

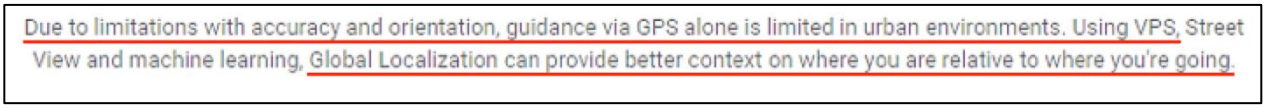
As your phone moves through the world, ARCore uses a process called simultaneous localization and mapping, or SLAM, to understand where the phone is relative to the world around it. ARCore detects visually distinct features in the captured camera image called **feature points** and uses these points to compute its change in location. The visual information is combined with inertial measurements from the device's IMU to estimate the **pose** (position and orientation) of the camera relative to the world over time.

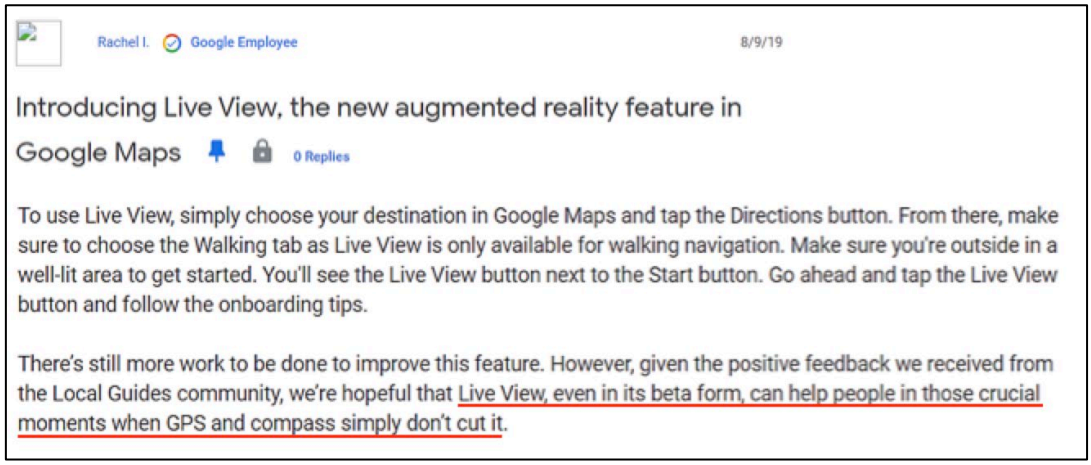
wherein the microprocessor uses the first data and the second data to calculate the position of the personal navigation device without using GNSS satellite signals.

Defendant's processor combines visual information taken from the camera and the input data from the IMU sensors to detect accurate position of the phone without using GPS signals.









43. Regarding claim 2:

The personal navigation device according to claim 1, wherein the data input means receives the first data from the user in an interactive manner by using information and commands made available by said portable navigation device to the user

The LG K92 smartphone includes a rear camera ("data input means"). While using Live View feature, user needs to grant camera access to Live View and Live View asks the user to point the camera at buildings and sings ("information and commands") so that Live View can identify current position of the phone using images captured by the camera.

Use Live View on Google Maps

Tip: When you try Live View for the first time, a message pops up on your phone to get access to your camera.

Android iPhone & iPad

Navigate with Live View

Google Maps offers two views for walking navigation: the 2D map and Live View. With Live View, you get directions placed in the real world and on a mini map at the bottom of your screen. You can use Live View navigation during the walking portion of any type of trip.

1. On your Android phone or tablet, open the Google Maps app .
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4. Above the map in the travel mode toolbar, tap Walking .
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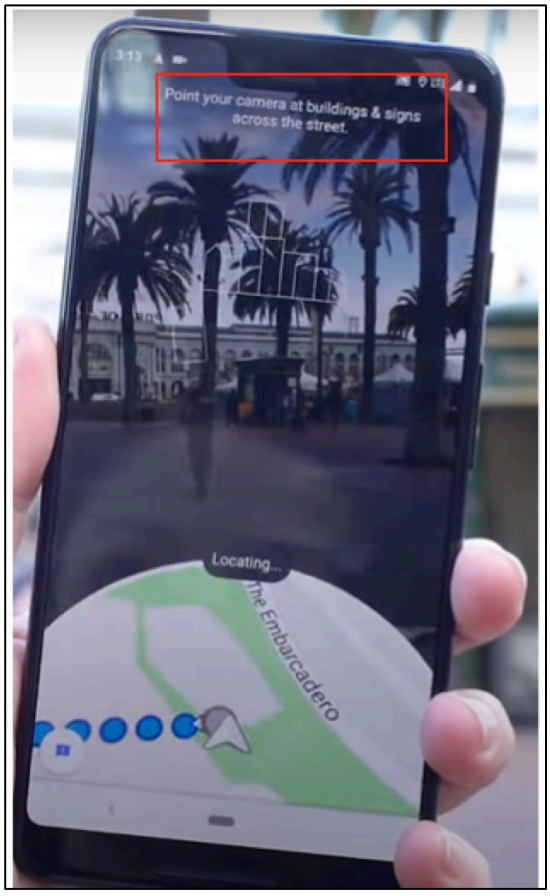
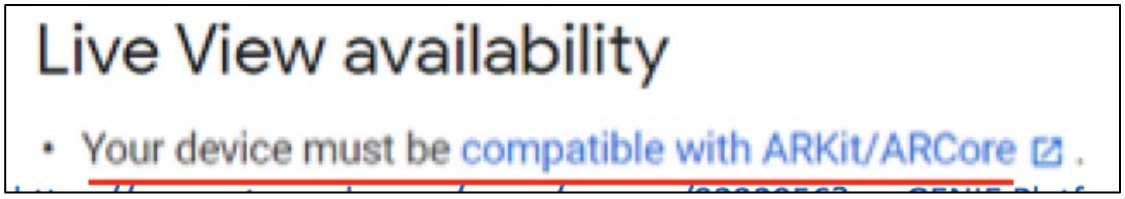
6. Follow the on-screen instructions to help Maps find your location.
   Tip: Point your phone camera at buildings and signs across the street, instead of trees and people.
7. Once Maps knows where you are, you'll get directions through the camera view on your screen.

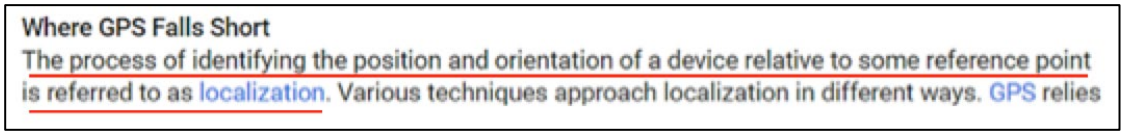


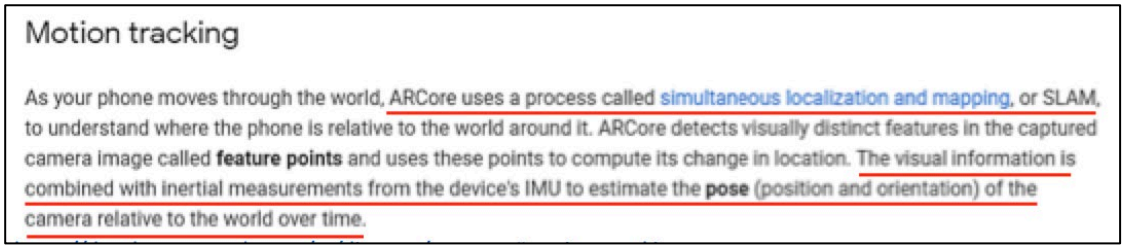
44. Regarding claim 5:

The personal navigation device according to claim 1, wherein said localization tools comprise an inertial system which uses said first data as an initial position to calculate subsequent instantaneous positions of said personal navigation device.

The LG K92 smartphone has inertial measurement units (IMU) sensors such as accelerometer, Gyrometer, Magnetometer ("localization tools"). Live View uses the Google ARCore's localization technology, which utilizes camera input to identify initial position, and subsequent position of the phone is determined using inputs from the IMU sensors.







Motion tracking

As your phone moves through the world, ARCore uses a process called simultaneous localization and mapping, or SLAM, to understand where the phone is relative to the world around it. ARCore detects visually distinct features in the captured camera image called **feature points** and uses these points to compute its change in location. The visual information is combined with inertial measurements from the device's IMU to estimate the **pose** (position and orientation) of the camera relative to the world over time.

45. Regarding claim 6:

The personal navigation device according to claim 1, further comprising a memory, wherein said first data comprise at least one of the following items:

an address of a place which is a starting point or a destination point of a route previously stored in the memory of the device; a point of interest stored in the memory of the device; a position recently obtained by the device through GNSS satellite signals; a geographic point stored in the memory of the device and previously selected by the user; a geographic place or address interactively selectable by the user based on a map stored in the memory of the device; a point on the map which can be displayed on a display of the device and which is selectable by the user.

The LG K92 has 128GB of storage space. Live View uses visual positioning service to determine a user's current location and shows points of interest present near the determined location which are selectable by the user ("a point on the map which can be displayed on a display of the device, and which is selectable by the user.").

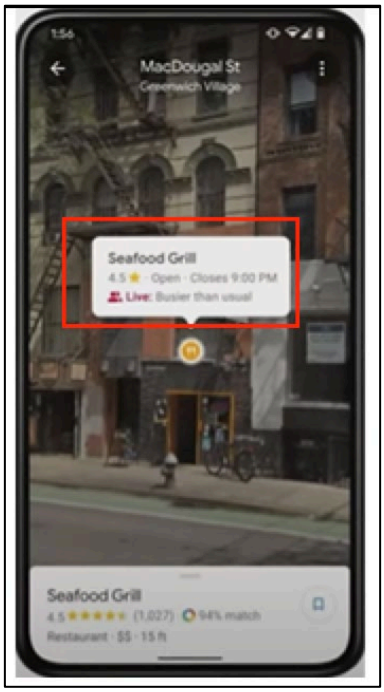
LMK920TM0AUCLTN

LG K92™ 5G | U.S. Cellular

Storage	128GB (up to 99GB usable)*
Rear Camera Resolution	64MP/W5MP/D2MP/M2MP Quad Cameras

A New Approach to Localization

VPS determines the location of a device based on imagery rather than GPS signals. VPS first creates a map by taking a series of images which have a known location and analyzing them for key visual features, such as the outline of buildings or bridges, to create a large scale and fast searchable index of those visual features. To localize the device, VPS compares the features in imagery from the phone to those in the VPS index. However, the accuracy of localization through



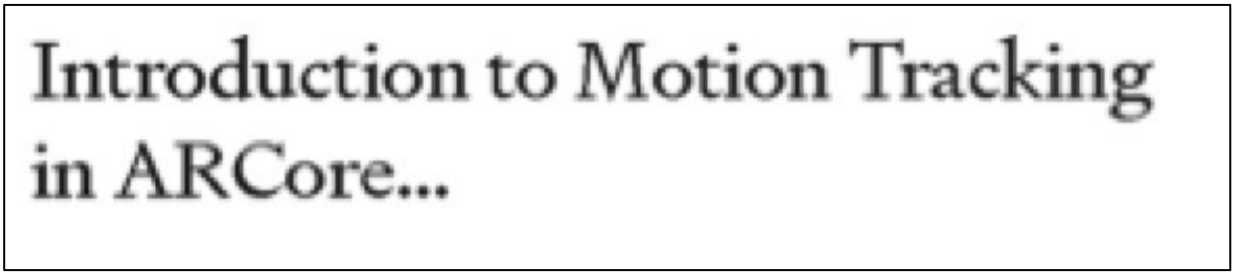
46. Regarding claim 8:

The personal navigation device according to claim 1, wherein said second data comprise at least one of the following items:

a direction of the terrestrial magnetic field in the current position; an elevation of the current position from sea level; a direction and an intensity of an instantaneous speed of the device or of a vehicle moving at the same speed; a space travelled by the device or by a vehicle which has travelled the same space as the device.

The LG K92 has inertial measurement units (IMU) sensors such as accelerometer, Gyrometer, Magnetometer ("localization tools"). The magnetometer is used to determine the

phone's orientation related to Earth's magnetic field and the accelerometer and gyroscope are used to determine orientation and acceleration/velocity of the phone.



Hardware that enables Motion Tracking

Accelerometer: Measures acceleration, which is speed divided by time. Simply put, it's the measure of change in velocity. Acceleration forces can be static/continuous — like gravity — or dynamic, such as movement or vibrations.

Gyroscope: Measures and/or maintains orientation and angular velocity. When you change the rotation of your phone while using an AR experience, the gyroscope measures that rotation and ARCore ensures that the digital assets respond correctly.

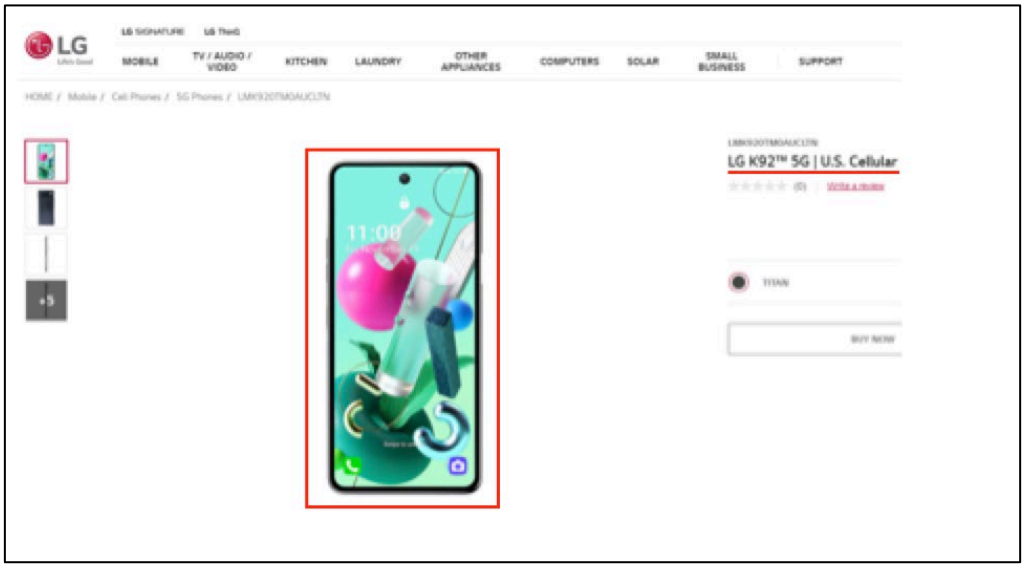
Hardware that enables location-based AR

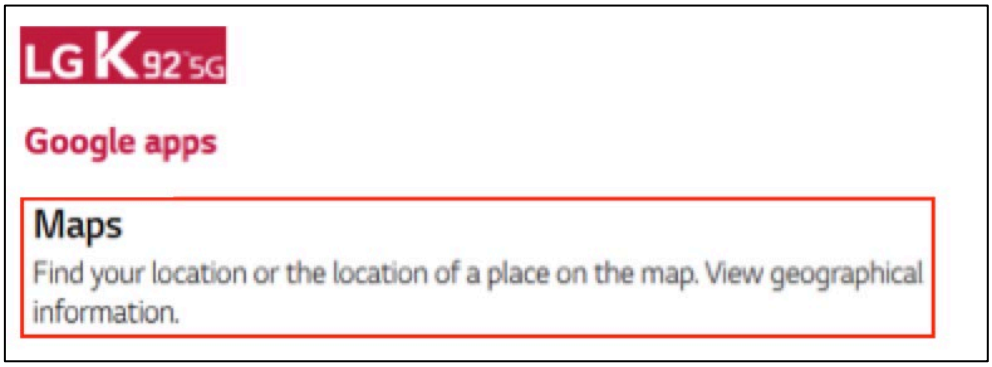
Magnetometer: Gives smartphones a simple orientation related to the Earth's magnetic field. Because of the magnetometer, your phone always knows which direction is North, allowing it to auto-rotate digital maps depending on your physical orientation. This device is key to location-based AR apps.

47. Regarding claim 15:

A method for ensuring continuity of service in a personal navigation device in an event of insufficient reception of GNSS satellite signals, the method comprising:

The LG K92 has pre-installed Google Maps, and it supports Google ARCore. Google Maps' Live View feature enables a user to pinpoint the phone's location where GPS signal is weak or unavailable such as in indoor or in urban areas having tall buildings. Live View uses Google ARCore's motion tracking technology or localization technique to determine a device's location where GPS signal is weak. The localization technique uses visual inputs from the phone's camera and combines them with readings from the phone's inertial sensors to determine the phone's location.





Use Live View on Google Maps

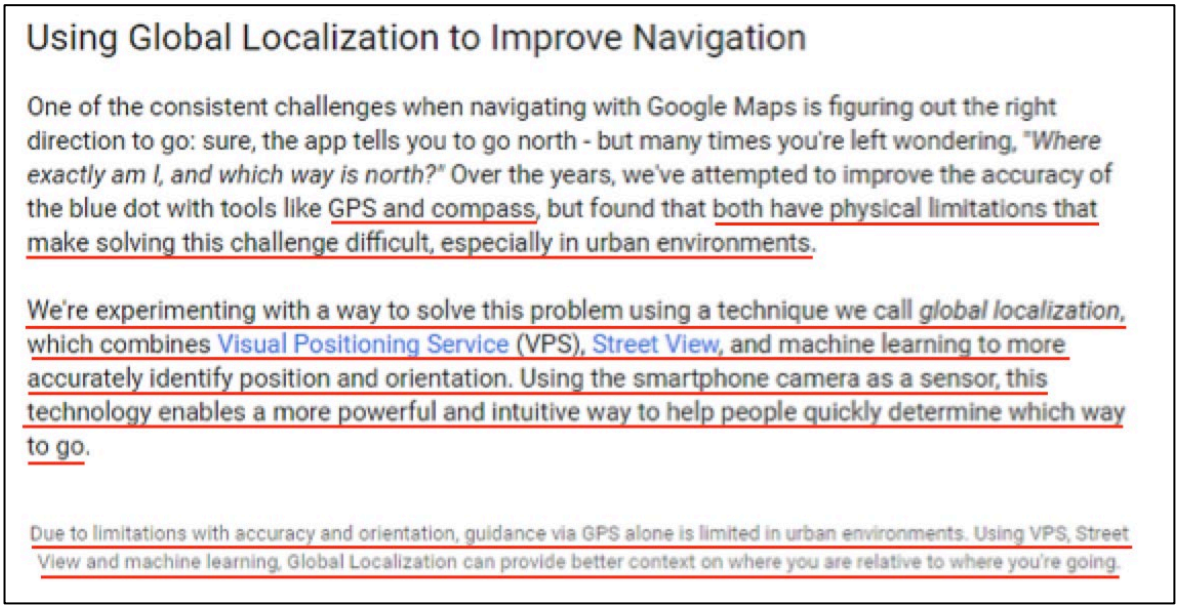
Discover and navigate places in the real world with the help of Live View.

Live View availability

- Your device must be compatible with ARKit/ARCore .

ARCore supported devices

Manufacturer	Device model
LG	K92



Using Global Localization to Improve Navigation

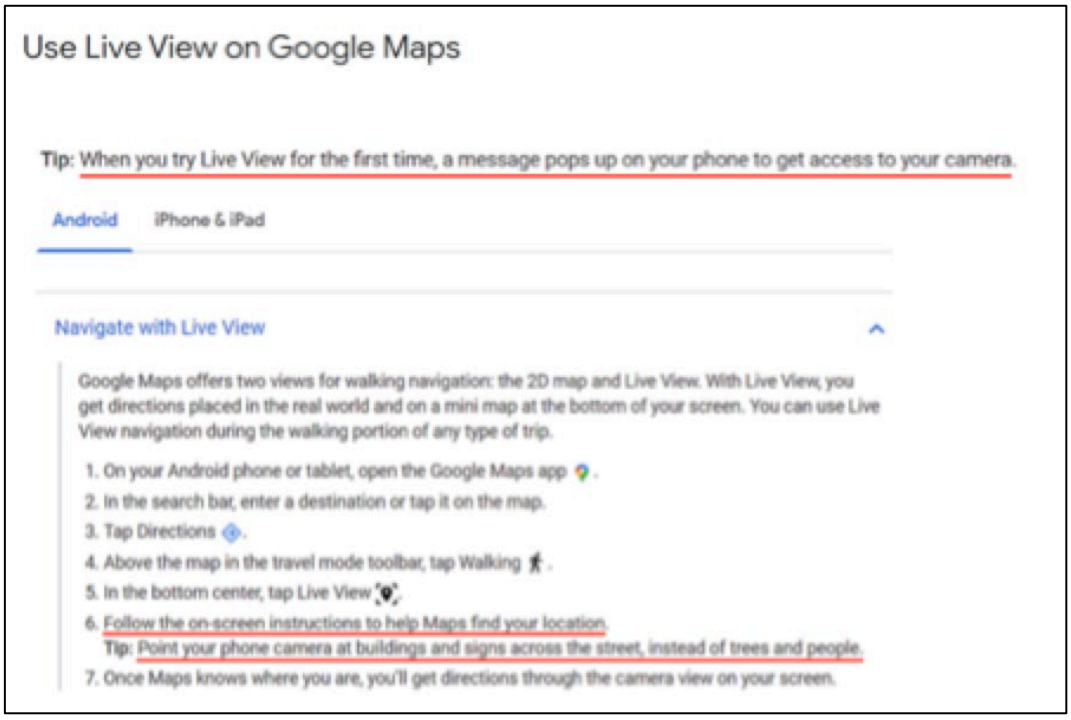
One of the consistent challenges when navigating with Google Maps is figuring out the right direction to go: sure, the app tells you to go north - but many times you're left wondering, *"Where exactly am I, and which way is north?"* Over the years, we've attempted to improve the accuracy of the blue dot with tools like GPS and compass, but found that both have physical limitations that make solving this challenge difficult, especially in urban environments.

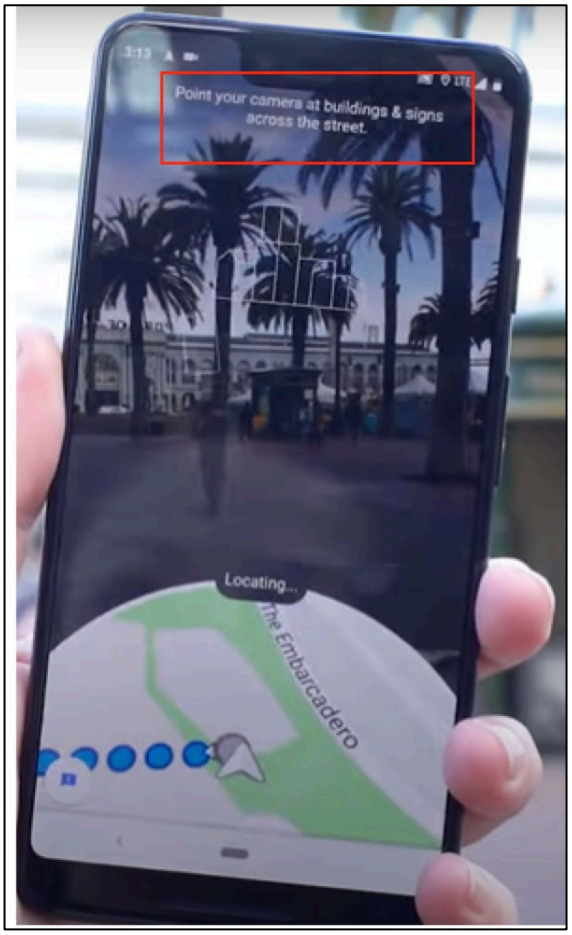
We're experimenting with a way to solve this problem using a technique we call *global localization*, which combines Visual Positioning Service (VPS), Street View, and machine learning to more accurately identify position and orientation. Using the smartphone camera as a sensor, this technology enables a more powerful and intuitive way to help people quickly determine which way to go.

Due to limitations with accuracy and orientation, guidance via GPS alone is limited in urban environments. Using VPS, Street View and machine learning, Global Localization can provide better context on where you are relative to where you're going.

acquiring a position of the personal navigation device manually from first data received through data input means for receiving the first data;

The LG K92 includes a rear camera ("data input means"). While using Live View feature, a user needs to grant camera access to Live View and Live View asks the user to point the camera at buildings and signs so that Live View can identify current position of the phone using images captures by the camera ("first data").





A New Approach to Localization

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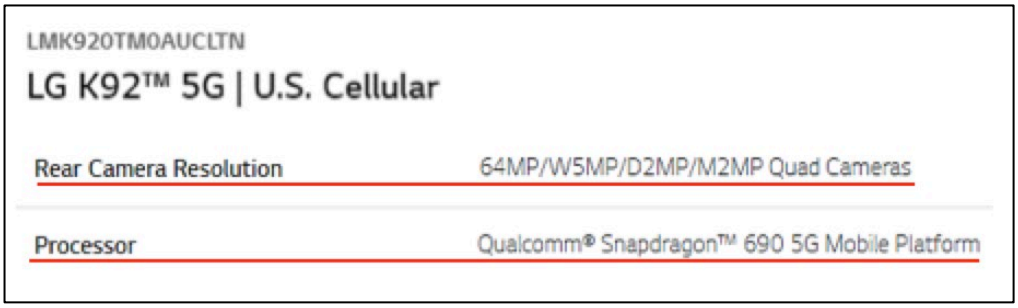
acquiring second data from localization tools configured to generate the second data. wherein the second data relates to the position of the personal navigation device; and

The LG K92 has a Qualcomm Snapdragon 690 processor which is connected to the camera and inertial measurement units (IMU) sensors such as accelerometer/Gyrometer/Magnetometer

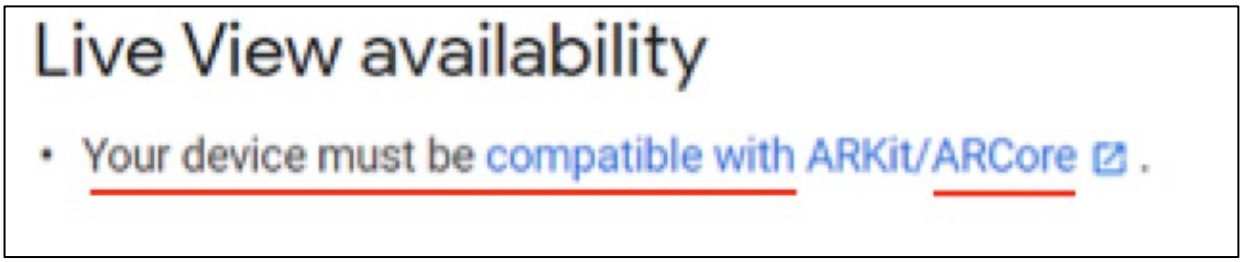
("localization tools"). Live View uses the Google ARCore's localization technology in which a phone position and orientation is determined using input from the IMU sensors ("second data").


LMK920TM0AUCLTN

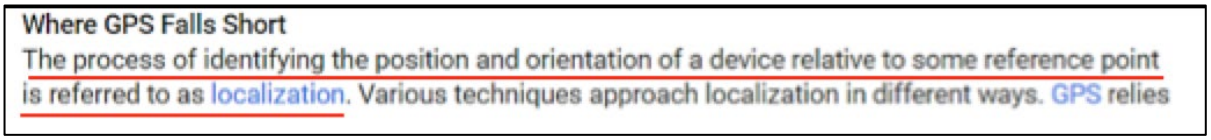
LG K92™ 5G | U.S. Cellular

Rear Camera Resolution	64MP/W5MP/D2MP/M2MP Quad Cameras
Processor	Qualcomm® Snapdragon™ 690 5G Mobile Platform

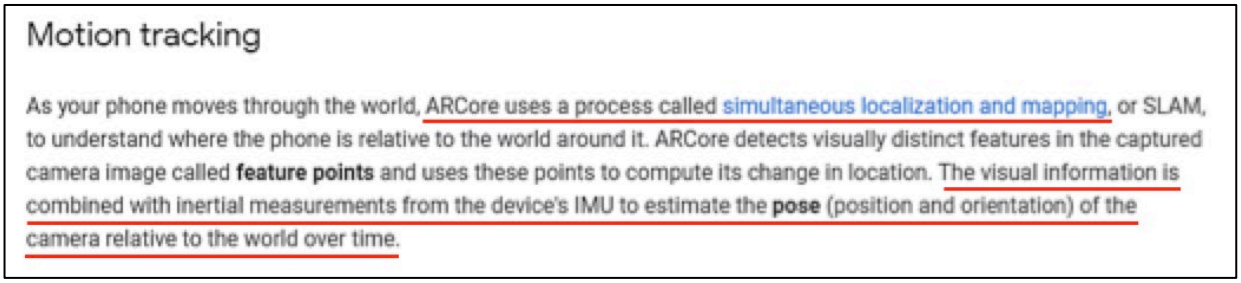

- **Sensors** – Gyroscope, Magnetometer, Accelerometer


Live View availability

- Your device must be compatible with ARKit/ARCore .


Where GPS Falls Short

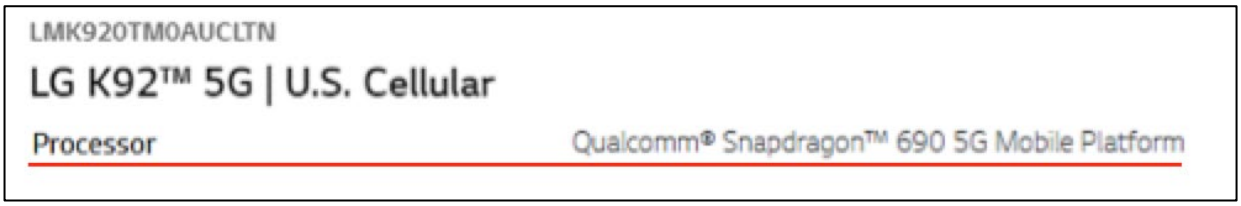
The process of identifying the position and orientation of a device relative to some reference point is referred to as localization. Various techniques approach localization in different ways. GPS relies

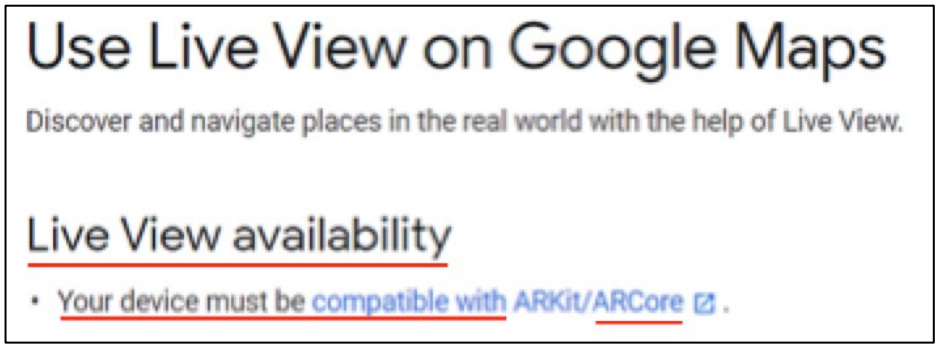

Motion tracking

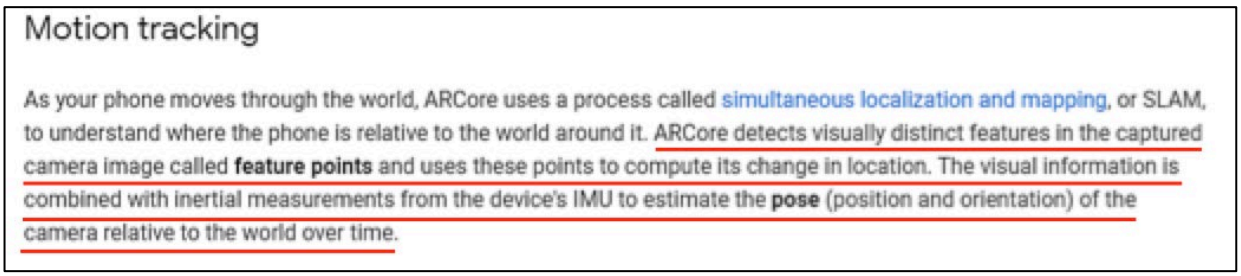
As your phone moves through the world, ARCore uses a process called simultaneous localization and mapping, or SLAM, to understand where the phone is relative to the world around it. ARCore detects visually distinct features in the captured camera image called **feature points** and uses these points to compute its change in location. The visual information is combined with inertial measurements from the device's IMU to estimate the **pose** (position and orientation) of the camera relative to the world over time.

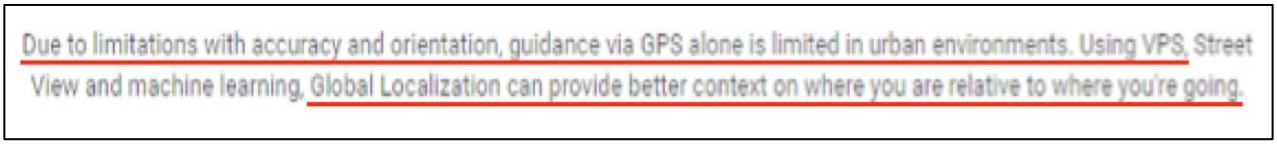
determining the position of the personal navigation device with a microprocessor that is connected to the data input means and the localization tools based on the first data and the second data and without using GNSS satellite signals.

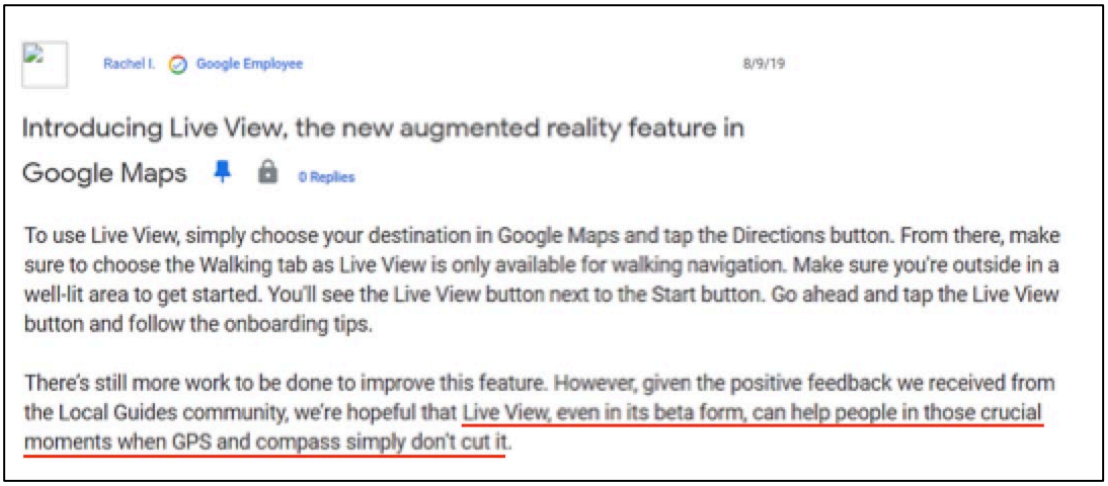
The Defendant's processor combines visual information taken from the camera and the input data from the IMU sensors to detect accurate position of the phone without using GPS signals.







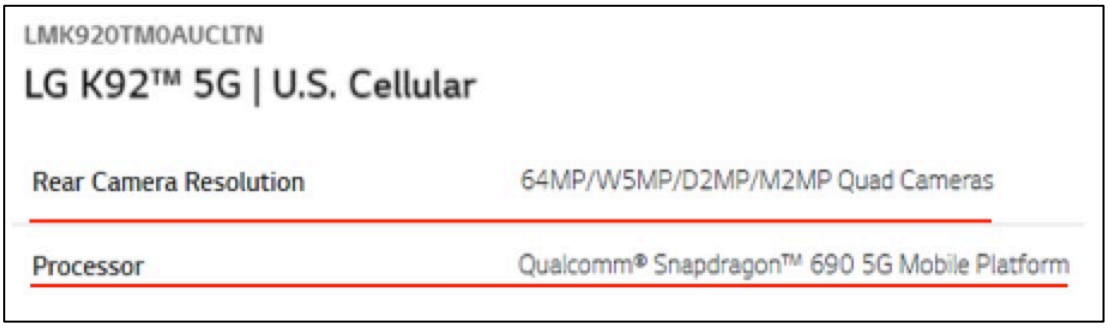


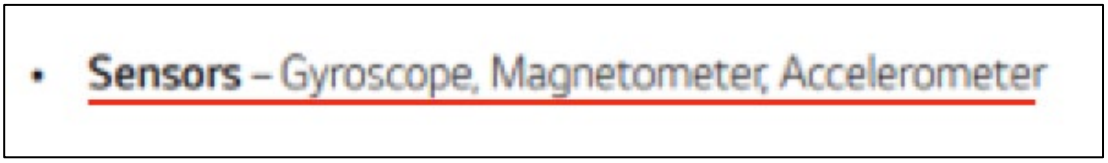


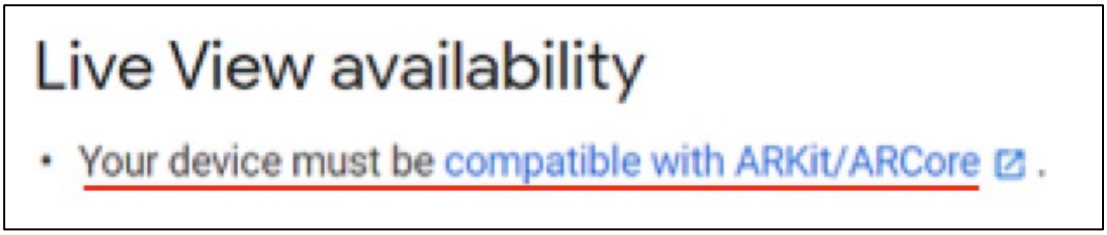
48. Regarding claim 17:

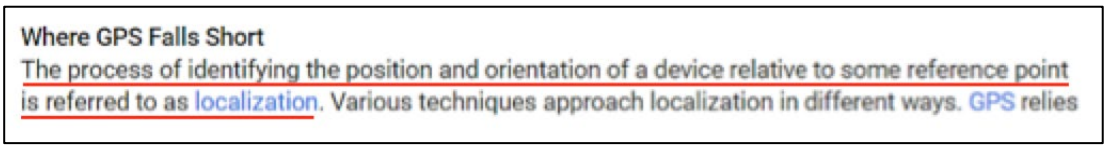
The method according to claim 15, further comprising the localization tools using an inertial system which uses said first data as an initial position to calculate subsequent positions of said personal navigation device.

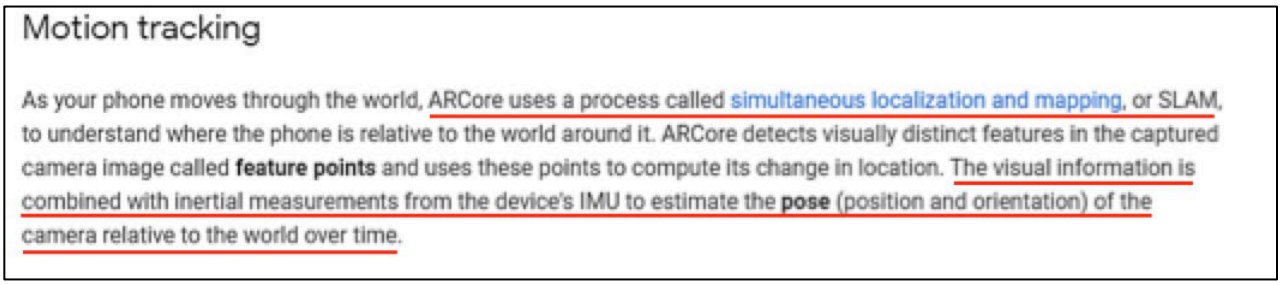
The LG K92 has inertial measurements units (IMU) sensors such as accelerometer, Gyrometer, Magnetometer ("localization tools"). Live View uses the Google ARCore's localization technology, which utilizes camera input to identify initial position, and subsequent position of the phone is determined using inputs from the IMU sensors.











49. Regarding claim 18:

The method according to claim 15, wherein the personal navigation device includes a memory, further comprising a receiving at least one of the following as the first data into the data input means: an address of a place which is a starting point or a destination point of a route previously stored in the memory of the device; a point of interest stored in the memory of the device; a position recently obtained by the device through GNSS satellite signals; a geographic point stored in the memory of the device and previously selected by the user; a geographic place or address interactively selectable by the user based on a map stored in the memory of the device; a point on the map which can be displayed on a display of the device and which is selectable by the user.

The LG K92 has 6GB of storage space. Live View uses visual positioning service to determine a user's current location and shows points of interest present near the determined location which are selectable by the user ("a point on the map which can be displayed on a display of the device, and which is selectable by the user.").

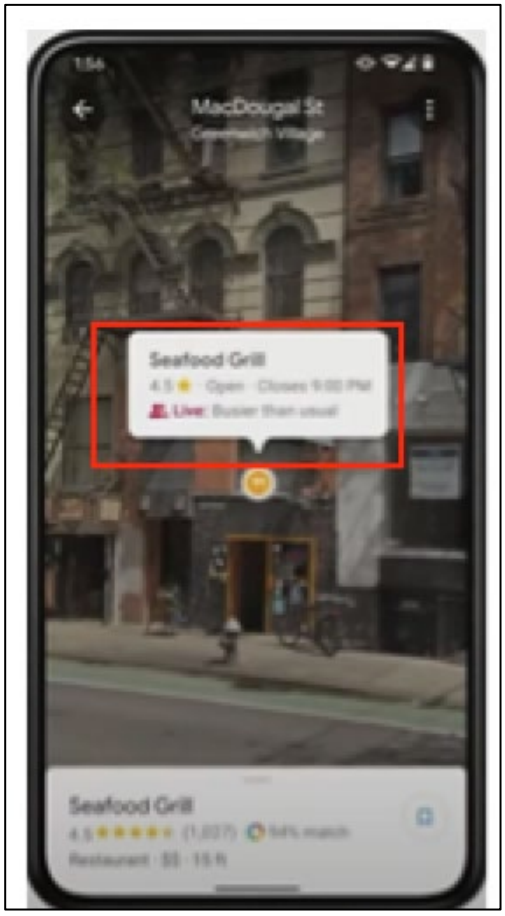
LMK920TMOAUCLTN

LG K92™ 5G | U.S. Cellular

Storage	128GB (up to 99GB usable)*
Rear Camera Resolution	64MP/W5MP/D2MP/M2MP Quad Cameras

A New Approach to Localization

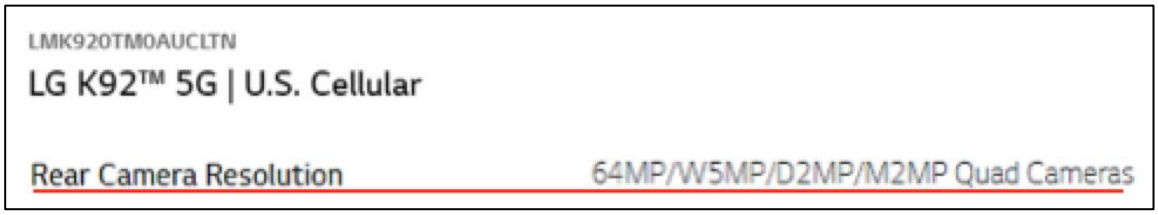
VPS determines the location of a device based on imagery rather than GPS signals. VPS first creates a map by taking a series of images which have a known location and analyzing them for key visual features, such as the outline of buildings or bridges, to create a large scale and fast searchable index of those visual features. To localize the device, VPS compares the features in imagery from the phone to those in the VPS index. However, the accuracy of localization through

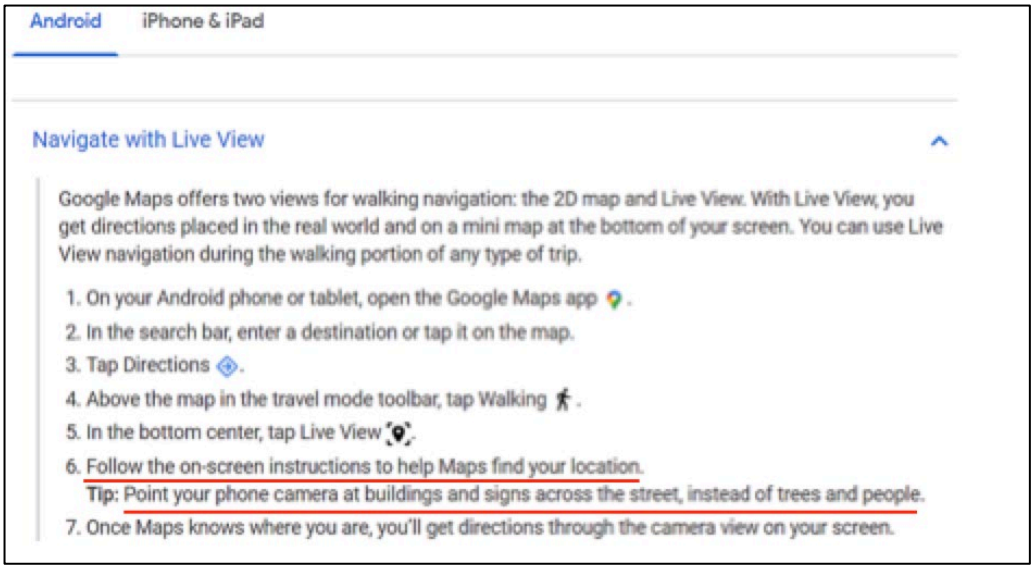


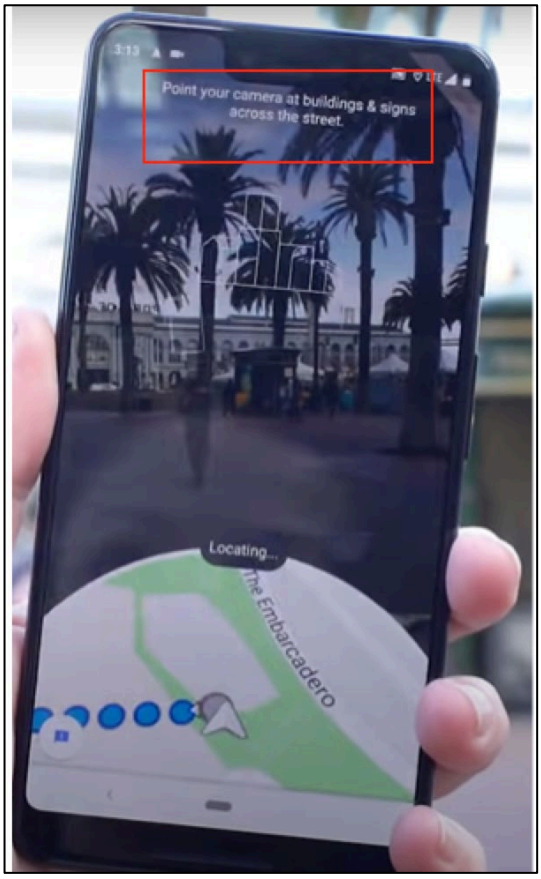
50. Regarding claim 20:

The method according to claim 15, further comprising receiving the first data in an interactive manner using commands and information that are presented on a display of the personal navigation device.

The LG K92 includes a rear camera (data input means). While using Live View feature, a user needs to grant camera access to Live View and Live View asks the user to point the camera at buildings and signs ("commands and information") so that Live View can identify current position of the phone using images captures by the camera.







47. Emergent Mobile has been damaged by the direct infringement of LG and is suffering and will continue to suffer irreparable harm and damages as a result of this infringement.

JURY DEMANDED

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Emergent Mobile hereby requests a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, Emergent Mobile respectfully requests that the Court enter judgment in its favor and against LG as follows:

a. finding that LG directly infringes one or more claims of each of the patents-in-suit;

b. awarding Emergent Mobile damages under 35 U.S.C. § 284, or otherwise permitted by law, including supplemental damages for any continued post-verdict infringement;

c. awarding Emergent Mobile pre-judgment and post-judgment interest on the damages award and costs;

d. awarding cost of this action (including all disbursements) and attorney fees pursuant to 35 U.S.C. § 285, or as otherwise permitted by the law; and

e. awarding such other costs and further relief that the Court determines to be just and equitable.

Respectfully submitted,

Ramey & Schwaller, LLP

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